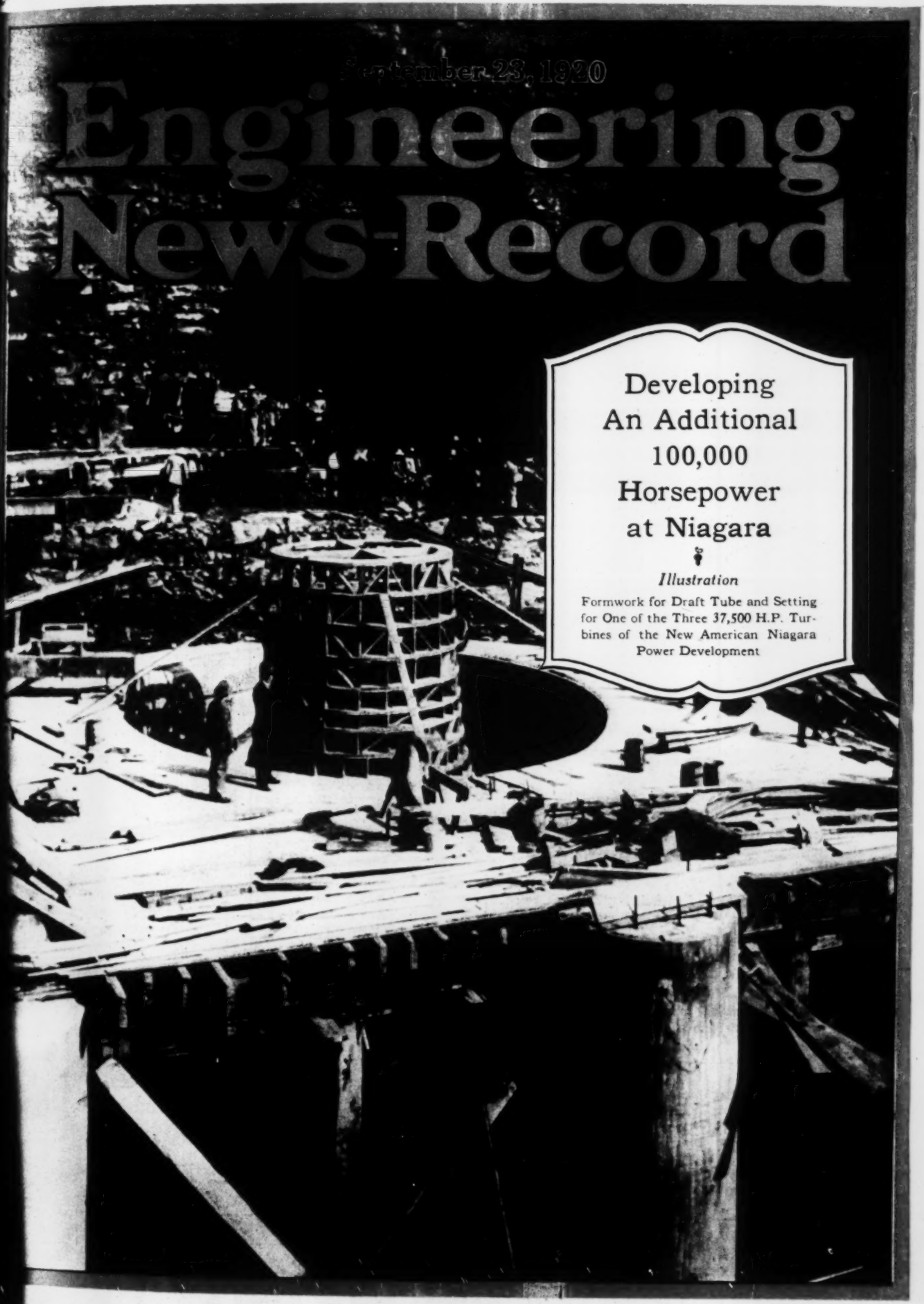
September 23, 1920

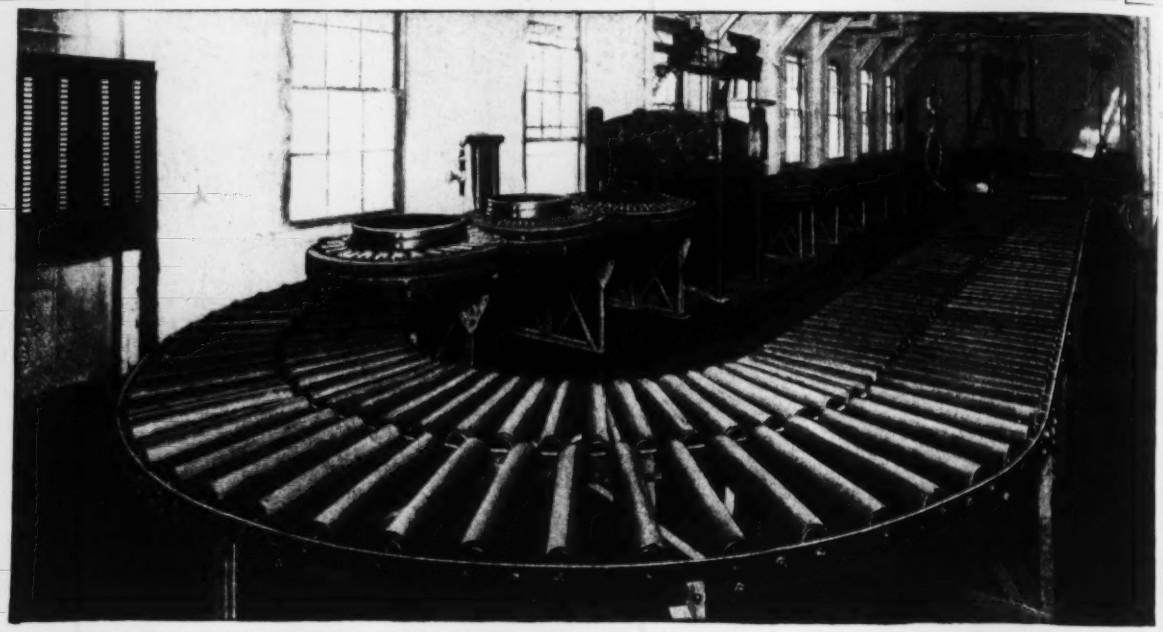
Engineering News-Record



Developing An Additional 100,000 Horsepower at Niagara

Illustration

Formwork for Draft Tube and Setting for One of the Three 37,500 H.P. Turbines of the New American Niagara Power Development



This is how the Converse Rubber Shoe Co., Malden, Mass., handles heavy molds through various tire-making operations. One of hundreds of Mathews Conveyer adaptations.

Gravity points the way to labor and power economy

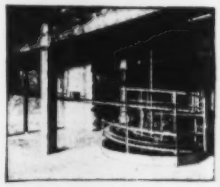
Lugging, carrying and wheeling are the drudge jobs in every industry. The labor they employ produces nothing. It can't be other than indifferent, inefficient, costly. For the monotonous grind leads nowhere—it destroys initiative, develops no skill, promises no advancement, holds no hope.

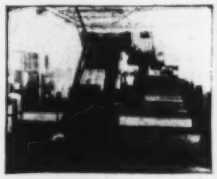
Switch more of this class of labor onto production jobs and you will have taken a long step toward cutting costs, increasing output and reducing factory overhead.

Mathews Gravity ball-bearing Roller Conveyers point the way. They have records of cutting handling expense as much as seventy-five per cent. Fifty per cent. is a fair average. You can easily figure the saving in your own plant—and when you've done that you'll quickly forget the cost of a Mathews system.

The Mathews enables quicker and more economical loading and unloading of cars and motor trucks; keeps work moving through the plant—operation to operation, floor to floor, warehouse to shipping platform, etc. The way it helps to speed up production, the way it cuts down time and power wastage by keeping hands busy and machines "fed", is a liberal education to any industrial head or production manager.

The operating force—*free gravity!* Thus the Mathews saves fuel as well as time and labor. (Occasionally a handling route may require a lift or two, in which case there's a Mathews Automatic Elevator to fit the need.) Could any industrial story be more interesting or timely than this? Write for the new Mathews catalog showing the great range of uses and installations (permanent and portable) of Mathews Conveyer systems.





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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 85 — NEW YORK, THURSDAY, SEPTEMBER 23, 1920 — Number 13

An Addition to the "Appeal"

A LETTER, signed by 82 of the 182 members whose names appeared on the "Appeal for a Progressive as Against a Radical Policy" for the American Society of Civil Engineers, is published in this issue. It pledges these members to work for two reforms which are the kernel of the progressive movement. The letter is an important clarification of the circular, which indicated that the signers favored changes, though only the one regarding the local sections was specified. The letter now pledges these men to work for two definite changes, and for a broadening of the technical life of the society. There were those who feared the "Appeal" was merely intended to postpone action with the hope of approving only ineffective and minor amendments in January. The letter dispels this fear. The signers give their word to their fellow members that if the pending amendments are rejected they will work for the two changes which are the essentials of the progressive movement.

A Fair Proposal

IN CASTING about for means of relief for the street railways the Federal Electric Railway Commission in its recent report proposed that the cost of street-railway extensions and of elevated railways and subways should be met by benefited property owners in the district served. The commission is justified in offering this plan for renewed consideration and is to be commended for pointing out the justice of the plan as a means of capturing some of the unearned increment of land values, due to electric-railway service, for the financing of the railways themselves. The committee does not go far enough in merely proposing that electric-railway extensions thus financed should not have their cost added to the capitalization on which dividends should be paid. In most cases, it seems certain, it would be necessary to make such extensions the property of the city. In fact, the city would probably have to make the extensions itself if their cost were to be assessed against all the property benefited. This would not preclude private operation under lease from the city. The data and opinions of the committee, as presented on p. 594, are well worth reading by all who are interested in the larger problems of both the street railways and the cities.

An Expert Opinion

AFTER the several reports of the Congressional committees which "investigated" war construction it is refreshing to read the analogous report of the Board of Review, which is abstracted on another page. The former are campaign documents, issued for political purposes; the latter is the unbiased judgment of technical men, two engineers and one public accountant. Though written before the Congressional fulminations, it constitutes a complete answer to such of them as tried to make out that the engineering and construction of the war was inefficient and ineffective, if not criminally inadequate. The board recognizes, as Congress did not, that hindsight is apt to be superior to foresight, and that the summer of 1917 demanded methods which would not have been tolerated in 1916 and which in the summer of 1920, with the war long over, can certainly be improved. The report confirms what the engineering profession has long known, that the war construction was a marvel of speed and effectiveness which contributed much toward the winning of the war.

Experience and a Works Department

IN ITS conclusions the Board of Review referred to in the preceding note very properly advocates a Federal Department of Public Works, but not under any specific name. It is, however, greatly impressed with the fact that the Construction Division of the Army, though under military control, managed to break for itself new paths of action through which it reached its ends unhampered by the time-worn restrictions of military personnel and methods. It therefore favors the retention of the methods and organization of this division for the Federal construction bureau, though it would divest it of all military character.

The problem of the Department of Public Works is not quite so simple as this would imply. The success of the Construction Division lay in its personnel. The drive of war led some of the clearest minds and highest executive talents in the engineering world to accept small salaried commissions or positions in which they worked under a pressure impossible to maintain in peace times. The methods evolved succeeded partly because they were taken directly from successful commercial and professional practice and partly because they had behind them enthusiastic men of superior experience.

To continue the success of such an organization, then, means more than merely to continue it as a government bureau, out of uniform. There must be maintained the quality, the initiative and the activity of a commercial or professional organization. In times of peace this ideal is probably impossible to attain, for any government organization suffers from the defects of its nature. A nearer approach to the ideal can be expected from a civilian rather than a military system because of a greater flexibility, a more ready infusion of new blood and a more democratic organization, but a constant fight will have to be made to avoid the dry rot and red tape of office, which threatens civilian as well as military government bureaus.

The prospects for a Department of Public Works are bright. Its organizers, when it comes, should not fail

to study the success of the Construction Division for pointers in their own problem. But they should not fall into the error of supposing that that division succeeded merely because it separated itself from military tradition.

Co-operation at Niagara

THERE is only one Niagara. Back in the wilds of the Southern continents there are falls as high and as voluminous, but nowhere else is the same combination of flow, head and power needs. Naturally, it has become the greatest center of hydro-electric development and the experimental ground on which the improvements in the art are being continually put to test. Every additional development of power there is therefore of the greatest importance and it is a privilege to be able to lay before our readers explicit accounts of the latest one. They begin in this issue.

Niagara's problems are to some degree its own, but their solution has universal applicability as well as the greatest general interest to the hydro-electric expert. The technical details of this new plant need little comment beyond the descriptions which will appear, except perhaps to call attention to the efficiency and the size of the turbines—the largest yet built but to be surpassed in the new Canadian plant across the river—and to the ingenious fall increasers or head regainers devised for the draft tubes. The method of machinery design is distinctly novel. When started, the addition was a wartime plant with all the necessities for speed that that implies. The power company, therefore, took the radical step of calling in the competing machine manufacturers, stipulating to them only the power bases and demands and leaving them full direction of the details of design and construction. The results were more than satisfactory. The essential speed in construction was attained as well as a commendably high uniform performance. All interests concerned testify to a pleasantness often lacking in contract relations and a concentration of effort which sunk personal glory in the patriotic endeavor to put enough current on the wires to carry through the supreme manufacturing necessities of the war. The armistice came before the completion of the plant, but the work on it was one of the high engineering achievements of the war.

Some Possibilities of Cast Iron

A DISCUSSION of the relative merits of different types and designs of cast-iron ties, published by the railway department of the Government of India, suggests a thought as to the development of this material for special purposes. Owing to its normal characteristic of brittleness and consequent liability to fracture, cast iron is regarded ordinarily as unsuitable for structures or parts subject to shock. The fact is not always realized that brittleness is a property not necessarily inherent in cast iron, and that engineering and metallurgical skill can adapt the metal to surprisingly severe service.

A striking example of the application of this metal under conditions where it is subject to shock is the American cast-iron car wheel, which has been a successful and standard railway appliance for many years. Another example is the cast-iron tie, which, in various designs, is used extensively in India and to some extent in South America. Engineers in this country discuss the cast-iron car wheel and its improvement as an ordinary engineering problem. The publication noted above shows that engineers in India discuss the cast-iron tie and its improvement in the same way.

Yet the American engineer looks with distrust at the occasional proposal to make a tie of cast iron, because "it is so brittle." Foreign engineers, in general, regard the car wheel of cast iron with even greater distrust, because "it is so brittle." In both cases cast iron is regarded as a material universally possessing a certain objectionable characteristic. As a matter of fact, by careful grading and mixing of the pig iron and by special methods in manufacture, the American engineer is able to produce a cast-iron wheel that is strong and tough, to resist the incessant shocks to which it is subjected, and that has also a hard surface, to resist wear. In the same way, the engineers of Europe and India who manufacture and use cast-iron ties have developed a grade of metal that is equally well able to resist the shocks sustained in railway track. It must be remembered also, that this applies not only to the mass of metal in the body of the tie but also to lugs and projections that form part of the rail fastenings.

Cast-iron guns and mortars, which were used with success in the Civil War, were suggested—and perhaps used—during the European war, owing to the possibility of speedier manufacture, compared with the ordinary methods of constructing modern cannon. Speed of production was the vital necessity at that time. Erosion of the bore by gases is one of the main considerations in the life of these guns, fracture under the shocks of firing being preventable by the use of proper design, proper metal and proper methods.

No argument is intended for cast-iron ties on American railways, or for cast-iron cannon. The purpose is to indicate that by continued study of the metal and a wider knowledge of its properties old prejudices may be overcome and the metal made even more useful to the engineer than it is today.

Life of Dredge Pumps and Pipe Increased Fourfold

ATTENTION is challenged by the remarkable record of improvements in dredging equipment which have been made at the hydraulic fill dams for the Miami Conservancy District. As enumerated in the articles in this and preceding issues, these improvements fall into two groups. (1) Improvements in pump construction which increase output life and (2) improvements in planning pumping plants which reduce operating heads. Briefly, the life of different pump elements has been doubled and quadrupled and even multiplied by ten, pumping resistances have been reduced, and plant operations synchronized. These improvements are more than mere technical refinements.

A quadrupled output life of dredge pumps and pipe line, which, in general, is what has been effected at the Miami dams, has a significance beyond the fact that a tool of greater durability has been secured for the constructor. The opportunity for economies which come from continuity of operation has been extended. With prices and wages high and trained construction workmen difficult to secure and to retain, equipment

delays exact a heavy penalty. The nearly tenfold increase in the life of pump impellers, which has been effected at Miami is a notable gain in structural perfection, but economically it is a far greater accomplishment to have divided by ten the number of delays for replacing worn impellers.

In this task of obtaining dredge pumps of greater durability there is also a lesson in co-operation. It is a pertinent saying that development of construction machinery is a *post factum* procedure. This is strikingly illustrated by the experience being considered, but this experience is to a degree exceptional in the respect that the engineers have acted quickly after the fact. Both in pump construction and pipe fabrication, the improvements enumerated are the result of records and analyses by the engineers quickly placed before the manufacturers, and of prompt effort by the manufacturers, encouraged by the engineers, to satisfy the need.

After the fact, also, have come the developments recorded of sump design and pump layout and of operating control devices. These developments followed the disclosure of unexpected friction heads. Heads, ranging from 6 to 12 ft. in 100 ft., due to friction, explain many things which have been done at Miami and which otherwise appear without justification. In particular they explain the seeming incongruity of hauling materials by train a few thousand feet to be pumped another one or two thousand feet. Incidentally they portray how limited has been our quantitative knowledge of the friction heads developed in pumping mixtures of earth and water.

It was with a similar lack of quantative data in almost every respect that the hydraulicking operations on the Conservancy dams were inaugurated. From the beginning the work has been, perforce, a vast experimental laboratory in hydraulicking methods. This is the good fortune of the engineer. He will never again, to such an extent, be compelled to approach the problem of dredging pumps without recorded knowledge. He will have available equipment more nearly developed to his requirements. This perhaps is the greater gain.

It is the distinction of certain engineering operations that they have markedly extended the boundaries of service of construction equipment. The building of the Chicago Drainage canal in 1893-7 took the tipple incline, the cableway, the cantilever crane and the rock channeling machine from their field of service in mining and ore handling and placed them among the major tools for excavating earth and rock. Similarly the building of the Miami Conservancy dams has extended the boundaries of service of hydraulic dredging equipment.

The Oneness of the Economic World

EMPHASIS has been repeatedly placed in the last six years on the closeness with which the entire world is bound together economically. We had it demonstrated to us before our entry into the war, and, as pointed out in an article on Switzerland in this week's issue, the Swiss, though a neutral nation, experienced a rise in materials and wages and are suffering today from shortage of housing, as are all the belligerent countries.

Without inquiring into the conditions, one should, therefore, say with certainty that South America had experienced the same economic effects as have been felt in other countries. She is far away from Europe, but not so far but what the bonds draw her into the economic union.

As a matter of fact, one finds practically the same conditions in South America as elsewhere. Verne L. Havens, editor of *Ingenieria Internacional*, has just returned from a seven months' trip in which he visited Peru, Chile, Argentina, and Brazil. He found a shortage of labor, particularly of skilled men. Wages have risen about 50 per cent, the working hours have decreased about 20 per cent, while production is only about 75 per cent of what it was seven years ago. As a result of these conditions, costs of production have more than doubled.

Likewise, there is housing shortage—very serious in the large cities.

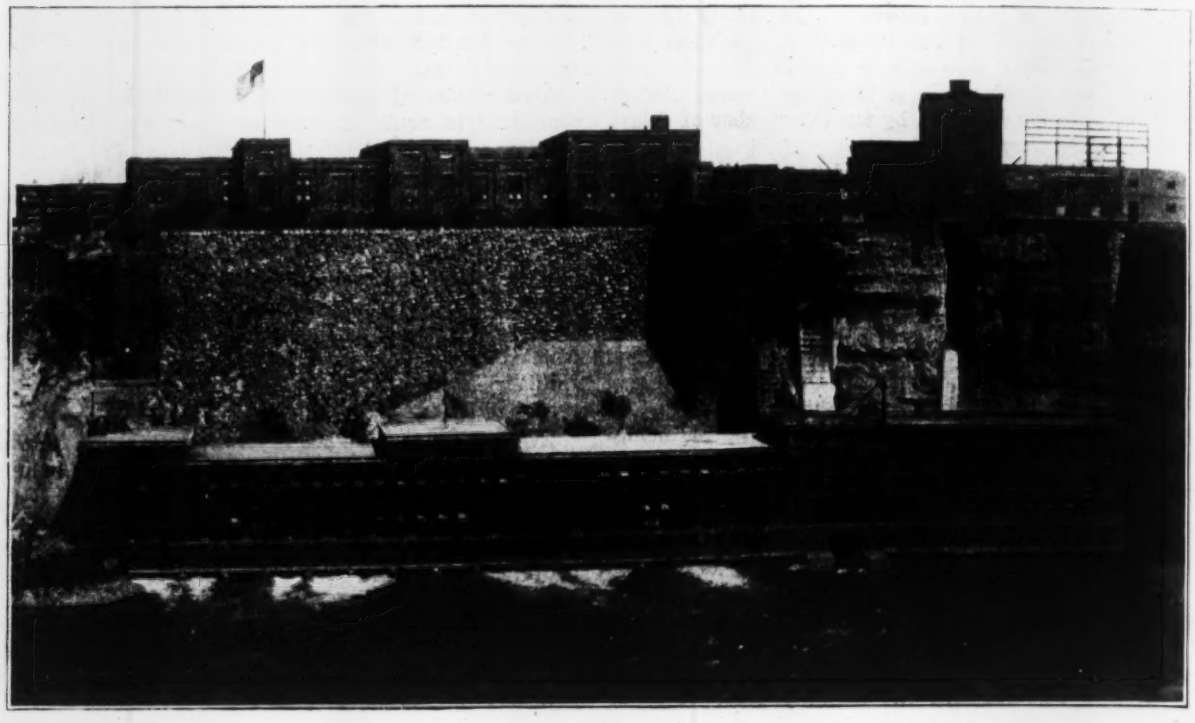
Everywhere, too, the attack on these problems for the purpose of solving them is the same—by a reawakening of the individual to his duty to render an honest day's work, and by the introduction of mechanical power to replace men wherever possible. In the application of both methods we in the United States have certain advantages, as compared with other countries, that in the one case should enable us to get back to normal more quickly than they, and in the other afford a large opportunity for export of American machinery.

In view of the unrest here and the lessened production per man, it seems hardly to accord with the truth to say that we have certain advantages with reference to the human element of the solution of the man-power shortage problem. Apparently we are no better off than other countries. However, America has always been an experiment station for proposals for bettering human relations in industry and the improvement of working conditions. True there is still much conservatism among employers even here, but far less than abroad. Our attitude toward the employee is more liberal than that in other countries, and we should accordingly go faster in the human part of the solution.

In the employment of labor-saving machinery, the field of application is necessarily larger in South America and in Europe than here. However, there is to be found there a good deal of inertia. They are not so accustomed to the application of machinery as we, and a lengthy educational process is needed. England is making rapid progress, however, evidenced by the fact that British manufacturers, for example, are imitating some of our types of construction plant never before manufactured, and seldom used, in England.

We have prided ourselves on an extensive use of machinery. The war, however, taught us that even we had a large field before us. The complexity of machines for doing even rough work is constantly increasing, and year by year intricate devices take the place of men in operations that a few years ago we thought were destined to be done by human power perhaps always. Despite, therefore, our already extensive use of machinery to replace human labor, and the great complexity to which such machinery has been developed, we can safely look for further progress, to the benefit of the public—always the ultimate beneficiary—and of those who have the ability to see the need and the resources and courage to make the necessary experimentation.

The oneness of the economic world, therefore, is emphasized not only by the widespread similarity of adverse conditions but also of the remedies proposed.



Developing An Additional 100,000 Horsepower at Niagara

Details of the Hydraulic and Structural Design and Description of Equipment of the Huge New Water-Power Plant on American Side of Falls

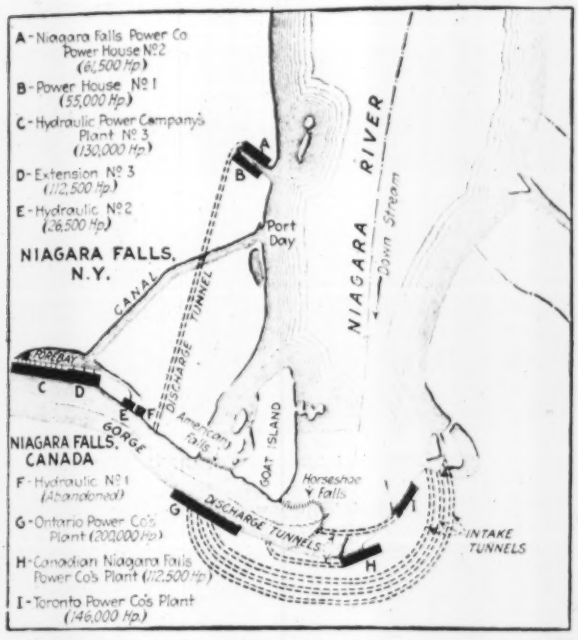
AT the time of the United States' entry into the war, the Niagara Falls Power Co. was entitled to draw from the Niagara River not to exceed 8,600 sec.-ft. and the Hydraulic Power Co. was entitled to 6,500 sec-ft. Very soon thereafter the need for power for war industries became so great that the War Department issued additional permits to both companies sufficient to cover the maximum output of the apparatus then installed. After the merger of the two companies and the agreement of the consolidated company to proceed immediately with a new development, permit was issued for the entire amount of water available to the United States under the treaty, or 19,500 sec.-ft. The normal capacity of the existing plants was sufficient to use 15,100 sec.-ft., leaving a balance of 4,400 sec.-ft. for a new development. This has just been completed, as an extension of the plant of the Hydraulic Power Co. The three hydro-electric units, rated at 37,500 hp. each, but with a combined station output of 100,000 hp. are the largest ever built and the whole plant has many elements of novelty. The series of articles beginning here has been prepared in collaboration with the power company and takes up the various phases of the design and construction. Credit for the various articles is given specifically in some cases, but in addition the information has been secured from memoranda from John L. Harper, chief engineer, G. R. Shepard, assistant chief engineer, N. R. Gibson, hydraulic engineer and O. D. Dales, construction engineer of the company. In the two succeeding issues will be taken up the hydraulic design and the construction features. The development would have been completed some time ago in record time, but work was slowed down after the armistice.

How the Needs of War Developed Co-operation at Niagara

By John L. Harper
Vice President and Chief Engineer, Niagara Falls Power Co., Niagara Falls, N. Y.

THE big electrochemical and electrometallurgical plants of the United States are at Niagara Falls, New York. When the war came, and shells and guns and ships and motor trucks and phosphorus and gas were found vital to the existence of the nation and its allies, our Government functioned through representatives whose minds appreciated values at Niagara other than in thundering vibrations and clouds of spray, wonderful as both may be in times of peace. In the presence of great dangers only the fundamentals count, and there was no hesitation on the part of the directors of the war in first restricting Niagara power to the manufacture of basic materials, and then demanding further development of power so that the production of these materials might be increased.

All parties interested in power development at Niagara Falls were asked to submit plans and propositions for a rush development of the remaining water available for diversion under the treaty with Great Britain. From these competitive plans, one of those presented by Hydraulic Power Co. of Niagara Falls was approved by the War Department as the one which would produce the largest amount of power in the shortest time, and at the same time be a proper and efficient power development after the stress of war had passed.


A - Niagara Falls Power Co Power House No 2 (61,500 Hp)
B - Power House No 1 (55,000 Hp)
C - Hydraulic Power Company's Plant No 3 (130,000 Hp)
D - Extension No 3 (112,500 Hp)
E - Hydraulic No 2 (28,500 Hp)
NIAGARA FALLS, N.Y.
Port Day
CANAL
DISCHARGE TUNNEL
NIAGARA RIVER
Down Stream
FOREBAY
GORGE
American Falls
GOAT ISLAND
NIAGARA FALLS, CANADA
F - Hydraulic No 1 (Abandoned)
G - Ontario Power Co's Plant (200,000 Hp)
H - Canadian Niagara Falls Power Co's Plant (112,500 Hp)
I - Toronto Power Co's Plant (146,000 Hp)
Horseshoe Falls
DISCHARGE TUNNELS
INTAKE TUNNELS

MAP OF NIAGARA FALLS DISTRICT, SHOWING LOCATION OF POWER PLANTS

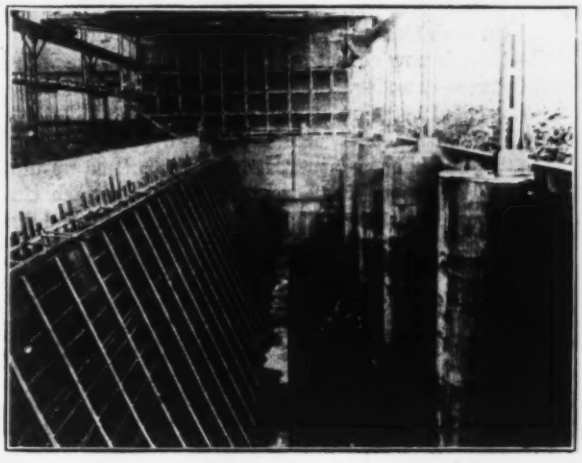
The plan so approved by the War Department required the use of all the water in respect to which the operating companies at Niagara Falls had proprietary rights. The consolidation of all the power companies was obviously the easiest way to unify these rights and upon suggestion of the War Department, such consolidation was undertaken. The Niagara Falls Power Co., Hydraulic Power Co. of Niagara Falls and Cliff Electrical Distributing Co. were consolidated under the name of The Niagara Falls Power Co., the control and management of the consolidated company resting in the former owners of the Hydraulic Power Co.

In the early part of May, 1918, authority was received from the Secretary of War with orders to proceed with the development in accordance with the approved plan under the supervision of an officer of the Corps of Engineers. The scope of the work carried out under this plan included the deepening of the intake from the Niagara River, the development and installation of improved ice deflecting booms, the deepening of the hydraulic canal through the City of Niagara Falls, N. Y., the construction of a new forebay, and three slope tunnels for taking the water from the forebay to the edge of the river in the middle basin, where the power plant was constructed as an extension to Station No. 3, of the Hydraulic Plant.

Three hydro-electric units were designed, to be equal in size, and to have a combined output at the highest efficiency of 100,000 hp. In view of the peculiar conditions that existed on account of the war, and in order to secure quick delivery, the contracts for the manufacture of the waterwheels and generators were distributed as follows: One complete hydro-electric unit to Allis Chalmers Manufacturing Co., two waterwheels to I. P. Morris Co., one generator to General Electric Co. and one generator to Westinghouse Electric & Manufacturing Co.

On account of the urgent need of this work by the War Department, A-1 priority orders were given by it to the builders for the obtaining of materials necessary for manufacture and construction, and sympathetic and effective assistance was rendered by all government departments in carrying out this work.

The contracts for the building of these waterwheels and generators were not placed on a basis of competitive prices, nor were specific guarantees of efficiencies exacted. As all of the power companies on the American side were to become one, it was deemed advisable to allow all of the larger manufacturers of this class of apparatus to show what they could do in the production of these new units, which were expected to be the last word in hydro-electric design. All of the manufacturing companies approached their tasks with enthusiasm and patriotic endeavor to produce the best, and now, when all three of these units are in operation, it is impossible to say that any better apparatus could have been constructed under the most minute specifications and inspection. All of these companies fully co-operated, not only with the War Department and the power company in meeting with dispatch the emergency requirements of rush production, but, at the same time, have given such careful and efficient attention to the whole design and manufacture that the resulting machinery is of the highest class known to



TRASH RACKS IN FOREBAY

the art, and, although the machines are of different manufacture, the builders have co-operated with each other in producing machines, the exteriors of which are similar, thus giving a uniform and pleasing appearance to the station.

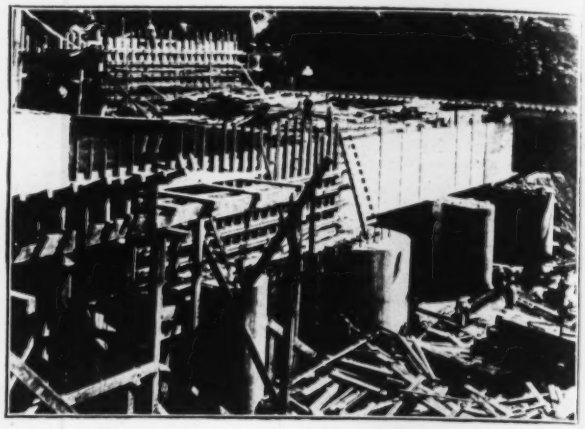
Although the official efficiency tests have not as yet been completed it is apparent, from preliminary tests, that the hydraulic efficiency will equal or slightly exceed 93 per cent, and that the efficiency from headwater to the switchboard will be over 90 per cent. The units have each demonstrated their ability to operate continuously at 40,000 hp., although the combined operating station output is considered as 100,000 hp.

These units are at present the largest hydro-electric units in the world, and it is a subject for pride in our American manufacturers that these four companies, as well as those manufacturing valves, bearings, etc., have mutually taken this step in advance without failure in any particular.

The construction work was carried out in the face of unusual obstacles in procuring both labor and materials, yet in all cases the manufacturers of the prin-

cipal parts of the apparatus lived up to their agreements as to time of completion; and if the construction and installation had been pushed with the same vigor after the armistice was signed as it was before, it is probable that the first unit would have been put in operation in fourteen months after the word was given by the Secretary of War; but, under the reduced schedule as to progress, the first unit was put in operation nineteen months after authority was received to proceed.

The writer also wishes to express appreciation of the loyalty and efficiency of the engineering and construction staffs of the Niagara Falls Power Co., which was obliged to make the plans at the same time that the work was in progress, and whose ability and efficiency may be measured by the fact that in spending about $8,000,000 less than $1,000 was wasted in changes of plans.



FOUNDATION SLAB FOR TURBINE SETTING

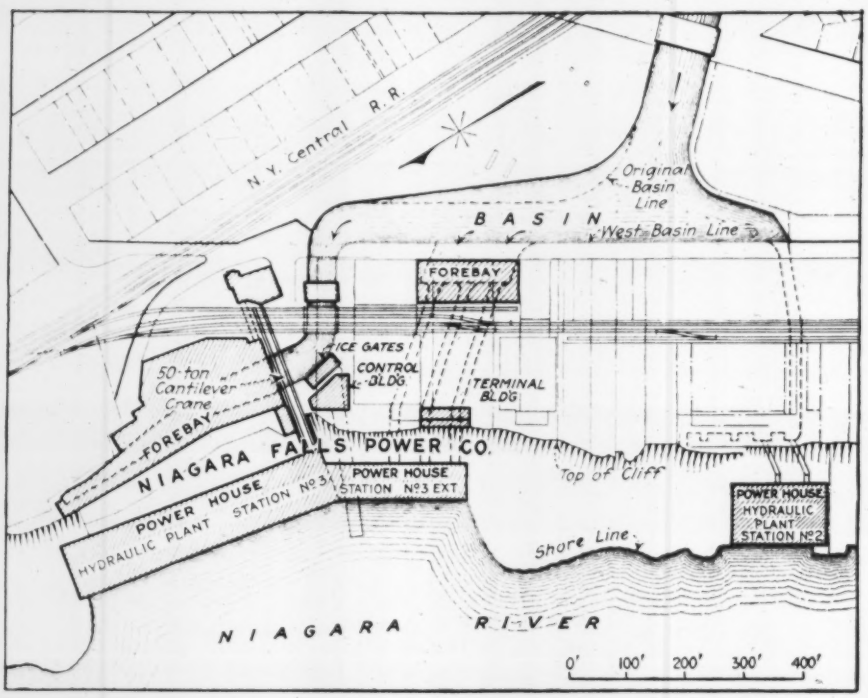
Structural and Equipment Features of New Niagara Plant

By O. D. Dales
Construction Engineer Niagara Falls Power Co.

STATION No. 3 of the Hydraulic Power Co., is located below the falls at the lower end of the canal passing through the city. It takes water from the canal through thirteen steel penstocks built outside the cliff—though now concealed from view by a face wall—and delivers it under 210 ft. head to thirteen horizontal turbines of 10,000 hp. capacity each. The canal was started in 1852 but was not put into operation until 1872. It has been enlarged from time to time up until 1912 when Station No. 3 was completed at which time it was 100 ft. wide and around 15 ft. deep and had an average flow of about 9,000 sec.-ft.

The 1918-20 extension to Station No. 3 was built immediately upstream of the 1906 plant. It consists of three 15½-ft. penstocks taking directly from the canal through a new forebay and passing through the limestone rock at a general slope of 45 deg. to the power house alongside the old power house just above the lower river level. Here are installed three vertical turbines of 37,500 hp. each, connected to generators of a capacity of 32,500 kva. each, generating 12,000 volt, three-phase 25-cycle current when operating at 150 r.p.m. The recent operations comprised additional ice protection in the upper Niagara at the mouth of the canal, enlargement of the canal to pass the required 13,200 sec.-ft., construction of the forebay behind a cofferdam holding back the canal, driving the penstock tunnels through rock, construction of the power house and erection of the hydraulic and electric machinery.

The Niagara River, at the point where the company takes its water, is a broad stream, and the main channel is near the Canadian side. Between the main channel and the company's intakes there is a broad stretch of water intersected with submerged reefs and ridges, and having a depth of from 4 to 14 ft. at the main stage of the water elevation.



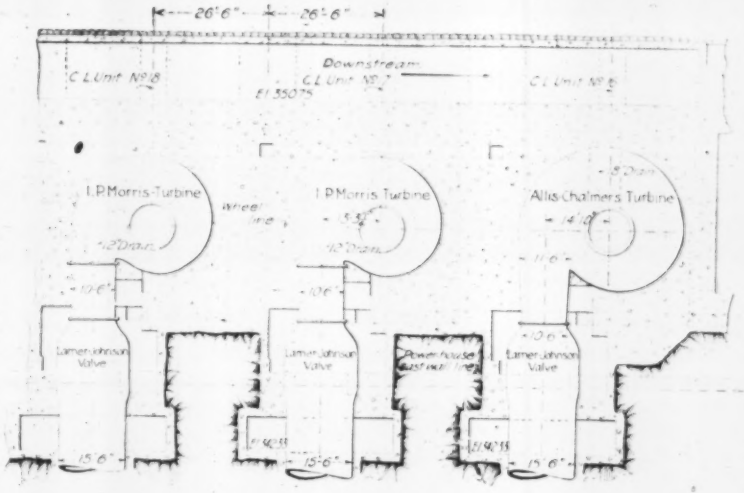
PLAN OF EXTENSION TO STATION NO. 3, NIAGARA FALLS POWER CO.

The engineering problem involved in the river work was to obtain the normal supply of water for the power plants during the winter period of low temperatures and severe ice conditions. The stream never freezes solidly over its entire width, and the outer line of the solid shore ice is located in approximately the same place from year to year. A deep channel about 200 ft. in width was run from the company's inlet outward to the edge of the ice line. Commencing at the intersection of this channel with the ice line, a series of piers consisting of steel sheetpile cylinders filled with concrete were built running upstream in the general direction of the ice line, but gradually working in toward the shore. Floating booms of

truss frames were placed from pier to pier. About half way between this row of piers and the shore, another row was placed, extending in the same direction and supporting floating booms in the same manner as the outer row.

This system has been in operation through one exceptionally severe winter and has proved entirely satisfactory. The booms have kept out the ice floating down the river, and what small amounts actually formed inside the booms, have been broken up from time to time in small quantities by the company's ice-breaking tugs and allowed to flow down the canal where it was disposed of through the spillway gates.

In order to get sufficient water through the canal to run the added equipment it was necessary to enlarge the cross section. The canal runs through the most thickly settled portion of the city, and it was impossible to acquire property rights to widen the canal, so that the only possible thing to do was to deepen it. The canal, prior to the enlargement, was 100 ft. in width and varied in depth, at the high water period of the year, from 15 to 22 ft. The new section is of the same width but has been deepened uniformly to 20 ft.



HORIZONTAL SECTION THROUGH TURBINE SETTINGS

DRAFT-TUBE FORMWORK FOR I. P. MORRIS UNIT

Forebay and Penstocks

The forebay is 154 ft. 7 in. long, 75 ft. wide, and 26 ft. 3 in. deep below normal water. It is entirely lined with concrete. Running out of the forebay are three penstocks, which are concrete lined tunnels of 15 ft. 6 in. diameter. The entrance to the penstocks is a bell-mouth 18 ft. 9 in. high by 28 ft. long.

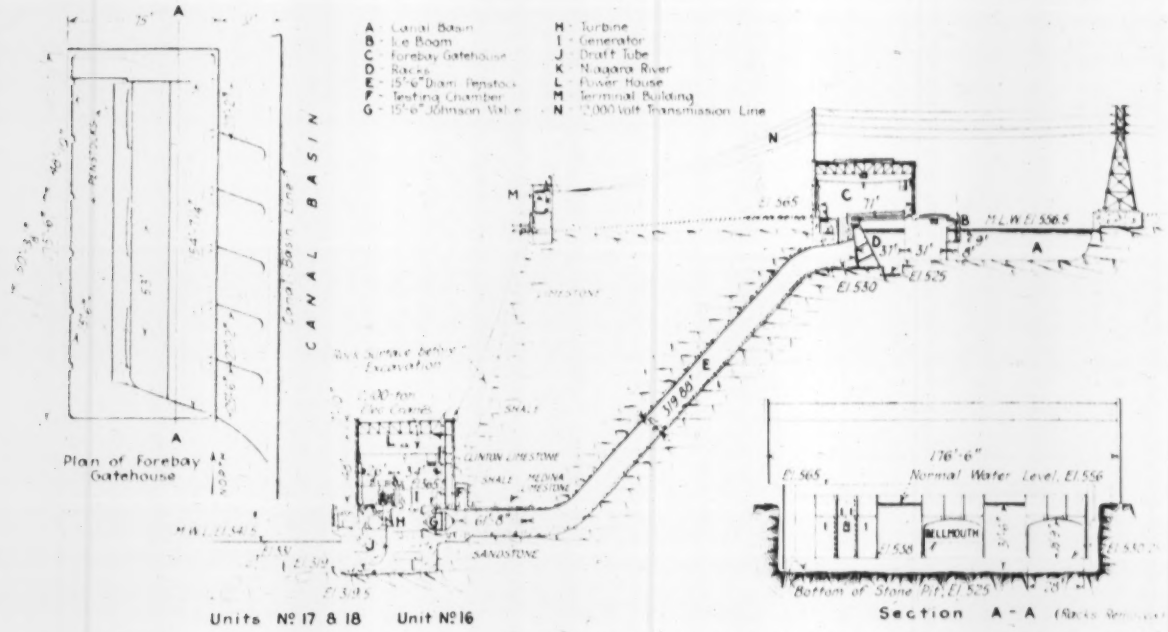
The penstock tunnels after leaving the bell-mouths turn downward at an angle of 45 deg. until they reach a plane at El. 353, which is on a line with the center of the waterwheels. They then run as horizontal tunnels out through the rock to the waterwheels in the power house. Of this horizontal part 76 ft. is composed of 1½-in- steel plate thoroughly riveted. The space between the steel lining and the rock is filled with concrete.

The valve for each unit was placed at the bottom of the penstock close to the turbine in order to save time when filling the penstock after the ordinary shut-down of a waterwheel. Stop gates were provided for the bell-mouth end as an extra precaution. These are merely large steel gates, three for each penstock, the center gate having a small by-pass wicket. These stop gates slide down in steel guides over the face of the bell-mouth. Steel lined grooves were placed in the face of the forebay wall to receive these stop gate guides.

Each of the three turbine casings is connected to its penstock through a Johnson hydraulically operated, electrically controlled valve. These valves, which are the largest in the world, were furnished by the Larner-Johnson Valve and Engineering Co. The outer valve housing is of cast steel and steel plate and is 17 ft. inside diameter through the body of the valve and tapers to 10 ft. 6 in. diameter at the outlet end. The entrance end to the valve housing is made of steel plate forming a flaring extension of the 15-ft. 6-in. penstock. The length of the valve is about 24 ft. Throughout the total length, approximately 24 ft., the area of the water passage is reduced without abrupt changes or sharp curves and the stream-line shape of the valve parts renders the hydraulic losses practically negligible.

Trash Racks and Stone Catcher

The trash racks which run the entire length of the forebay are composed of 4 x ½ in. flat steel bars spaced by cast-iron spreaders 4 in. centers. These racks are supported by a framework of steel designed with the assumption that the racks might become clogged and carry the entire hydrostatic pressure. The steel sup-



CROSS-SECTION OF NEW STATION WITH THREE 37,500 HP TURBINES AND STATION RATING OF 100,000 HP

ports are designed to carry the entire head with a working stress of 100 per cent greater than the usual working stress called for in the ordinary design.

In the bottom of the forebay and in front of the racks is a long groove running the entire length of the forebay, being 5 ft. deep. It is placed there to act as a stone catcher. As excavation will be carried on in the canal for some time after the completion of the station, loose rocks will be carried down the stream by the swift current and brought into the forebay. As the water in the forebay moves at a velocity of about 1½ ft. per sec. they will drop into this groove and not be carried down the penstock. When this stone catcher becomes filled the loose rocks will be removed by a grab bucket operated from the electric crane in the forebay house.

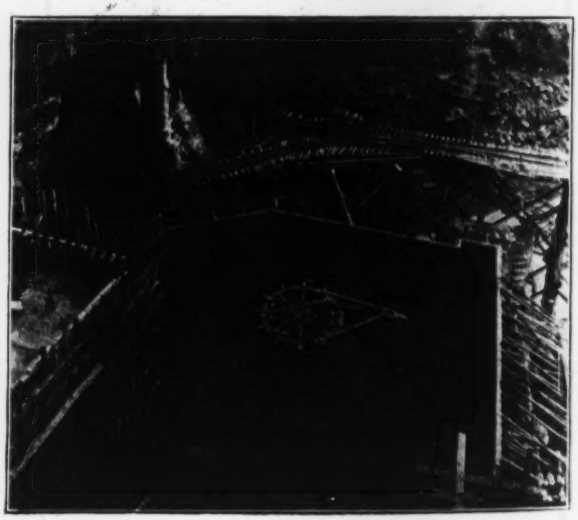
Ice Skimmer and Run

To prevent ice coming into the forebay an ice skimmer was built in front of the inlets. This consists of removable steel plate sections which extend 9 ft. below the water surface and are hung from the roadway slab above and braced laterally by steel framing to the concrete inlet piers. They will receive considerable pressure if large amounts of ice should be flowing in the basin. It was assumed that very little ice would be carried into the forebay as the velocity of the water in the basin is about 4.5 ft. per sec. and the water going through under the ice boom from the basin is 2 ft. per sec. This was very well proved by the experience of last winter.

By the construction of the ice boom system off Port Day in the Niagara River, it was believed that there would be very little trouble from ice in the forebay, but there will always be some ice form in the canal and there will always be the possibility that an ice boom might break and a large quantity come down the canal.

To take care of this a spillway and ice chute has been constructed. The old Station No. 3 had ice gates and an ice run running from the outside of the curve shown on the accompanying plan. This old ice run curved at a right angle and discharged into what had been the abandoned wheelpit of a large flour mill. This pit extended 70 ft. down from the top of the cliff, where the water and ice were discharged on the site of the new power house. It therefore became necessary to build a new ice run running directly from the old spillway gates to the river and passing under the new power house. Its location is shown also on the plan. It is a concrete lined chute 20 ft. wide and 15 ft. deep, inclined at an angle of 60 deg. with a horizontal with a parabolic curve at the top and bottom to connect the horizontal sections with the slope section.

The concrete lining of the chute was intended to be 18 in. thick, but it over ran this as part of the excavation was in shale which disintegrated after being exposed to the air. A concrete roof has been placed upon this chute and will later be covered with rubble stone masonry to look like the natural cliff. The horizontal part of the chute which passes underneath the power



REINFORCEMENT OF SETTING FOR ALLIS-CHALMERS UNIT

house is carried 60 ft. west of the power house so that the water, ice and débris will discharge into deep water of the river.

Details of Turbine Settings

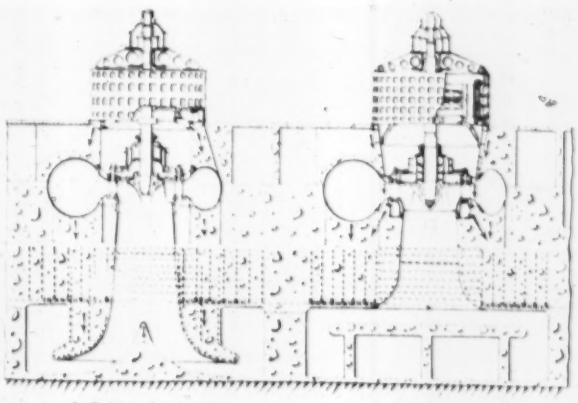
By Louis S. Bernstein
Designing Engineer, Niagara Falls Power Co.

THE hydraulic efficiency of the waterwheel unit was the governing feature of the design and for this reason and the fact that the size of the machines are larger and of different type than any in present use, radical departures were made as compared with the existing plants of the company. The fundamental features of the changes are as follows: (1) The vertical shaft type unit was adopted. (2) The usual bent tube type of draft tube was abandoned for the more efficient types known as the "hydraucone" and the "center cone," respectively.

In plants where the combination of a moderate discharge and the bent-tube type of draft tube exists, the

ICE CHUTE BEFORE COVERING

problem of supporting the turbine and generator is comparatively simple, as the loading is usually small and the natural arch of the bent tube acts as the support on one side, and the concrete mass foundation as the support on the other side. It can readily be seen that as the unit becomes larger and both the clear span of the tailrace and the load to be supported becomes greater, if the arch type of construction is not available, the problem of supporting the unit becomes more complicated; in special cases, where the turbine and generator are of extreme size and weight, special provision must be made to take care of the vibration of the machine as well as the superimposed loads.



VERTICAL SECTION THROUGH TWO TURBINE SETTINGS

There are two types of units, one being installed by the Allis-Chalmers Co., and the turbine of the other by the I. P. Morris Co. The draft tube of the Allis-Chalmers' unit is known as the "hydraucone," while that of the I. P. Morris is known as the "center cone." In each case the clearness in the tailrace and the other hydraulic features of the draft tube were determined by the makers of the respective turbines and the hydraulic engineer of the power company. Details of the machines and their appurtenances will appear in a later article.

The draft tube of the Allis-Chalmers' unit consists of a horizontal reinforced-concrete plate supported by three reinforced-concrete walls, the entire structure being centered in the tailrace directly under the discharge of the turbine. The draft tube of the I. P. Morris Co. unit consists of heavy flared reinforced-concrete wings suspended from the foundation slab of the unit and a center cone extending up between and centering these wings. The foundations for the units outside of the draft tube are practically the same. A cross section through both units is shown in an accompanying drawing.

Condition of Turbine Loading

In the Allis-Chalmers' unit the generator is supported by a heavy cast-iron frame called the "pit liner," having a top diameter of 22 ft. 4 in., a diameter at the bottom of 17 ft. 2 in. and a height of 9 ft. 4 in. This is carried by the speed ring which is a circular steel casting that acts as a stationary guide for the water entering the runner. The speed ring in turn is supported by another circular casting called the "discharge ring." This casting rests on the foundation slab, and the concrete inside of this casting is cut out and formed to the shape of the draft tube. The diameter of the opening at the top of the foundation slab is 10 ft. The opening gradually increases in size through the slab and becomes tangent at the bottom. The diameter at the point of tangency is 24 ft. 4 in.

In the I. P. Morris unit the generator is supported by massive concrete piers which rest directly on the heavy cast-iron wheel case. The load is transferred from the wheel case to the foundation slab and the distribution is more favorable than in the other unit. The flared wings of the draft tube are attached to the bottom of the main foundation slab with three rings of reinforcing bars. The opening in the main slab is similar to that of the Allis-Chalmers' unit.

The actual weight of one complete unit consisting of one generator and turbine is in excess of 1,000 tons. The entire weight from power house floor to the top of the tailrace on the neat inside line of the foundation piers is 5,500 tons per unit. It was assumed that this entire load was carried by the main foundation slab. The amount of arch action was impossible to determine owing to the nature of the load concentration of the machine in the vicinity of the opening for the draft tube.

The main foundation slab is 11 ft. thick. It has a clear span of 45 ft. The reinforcing consists of eight bands of steel bars, each band containing twenty-five 1¼-in. square bars. In addition to this there are about 450 vertical 1-in. square bars, spaced about 2 ft. centers over the entire area acting like stirrups. It was thought advisable to tie this large mass of concrete together since there is about 1,000 yd. of concrete in each slab, and for construction reasons it was decided to pour this slab in two sections. In addition to these vertical bars, limestone plums were placed so that about one-half of the stones projected above the neat line of the first pour to act as an additional horizontal tie. The entire surface was picked, roughened and thoroughly cleaned before the final pour was made.

In the design of the main foundation slab each band was considered acting as a beam and assumed to carry one-eighth of the total load inside the neat line of the foundation piers, the load being considered as uniformly distributed. Based upon this assumption the unit stress in the reinforcing steel is 15,000 lb. per square inch and in the concrete 450 lb. per square inch. The unit shear on the neat line of the foundation piers is 45 lb. per square inch.

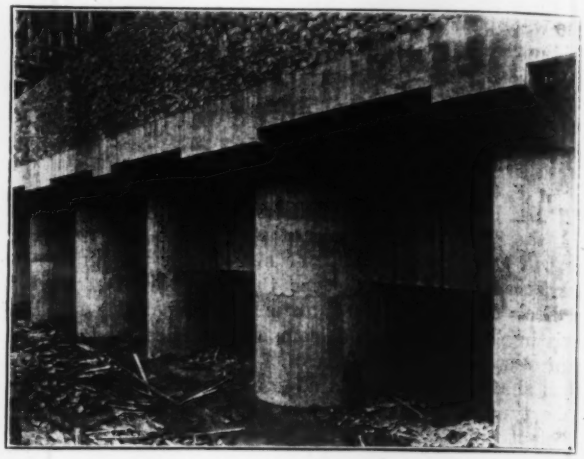
The foundation slab is carried by the main power house piers, which are spaced 53 ft. centers, and one smaller center pier. The main piers are 13 ft. thick at the river face of the power house and gradually taper down until they are 8 ft. thick at the center line of the unit. These piers are joined together from this point by a concrete wall 4 ft. thick, against the bedrock, having a radius of 22 ft. 6 in. to the inside face. This makes a horse-shoe shaped tailrace, semi-circular at the rear end and slightly contracting until it reaches the river face of the power house. The piers are rounded off to a radius of half their thickness at the river face of the foundation.

Superstructure of Power House

The power house, which is located in the gorge, is a building 60 ft. wide inside with a 6-ft. space between the back wall and the cliff, this space being used for cable and hot air passages. It extends 225 ft. upstream from old Station No. 3. The floor of the power house is at El. 365, which is 7 ft. above the highest known water level and is 23 ft. 6 in. above mean water level. The roof is 80 ft. above mean water level.

The operating gallery is 20 ft. wide and extends along the entire west side of the building and is 13 ft. 3 in. above the power house floor, being on a level with the walks leading to the top of the generators and around the Kingsbury bearings.

The east wall of the power house is of concrete and the west wall which faces the river is of rough rubble masonry, being the same as all masonry walls used in the construction of Station No. 3. This type of masonry is used as it harmonizes the best with the existing cliffs.



TAIL RACE EXIT OF EXTENSION TO PLANT NO. 3

The weight of the rotating parts of one unit is about 200 tons. Two 100-ton cranes and a lifting beam constituted the crane equipment for the installation of the new plant. The total moving load transverse to the building consists of the live crane load, the weight of the lifting beam and the crane trucks, making a total load of 260 tons. The moving load in the longitudinal direction of the building consists of the weight of the crane bridge in addition to the transverse loading, making a total load of 340 tons. The coefficient of sliding friction between the wheel and the truck was assumed as 0.2. This gave a transverse force of 104,000 lb. and a longitudinal force of 136,000 lb. applied at the top of the crane girder to be taken care of in addition to the regular maximum wheel loading of 76,000 lb.

In the design of the steelwork it was assumed that an equal portion of the lateral load would be taken by the top flange of each set of crane girders. The top flange of the crane girders was proportioned for the combined stresses due to the vertical and lateral forces, the span length in each case being the distance between the column centers.

The columns and trusses were designed as a portal fixed at the base. The lateral reaction from the crane girder was assumed to be taken by both the crane column and the truss column. The amount taken by each of these members was determined by the lateral deflection in these members for their particular condition of loading.

The longitudinal force from the crane was assumed to be taken by the crane column, knee braces and the crane girder. In determining the final sections the allowable unit stress in all members that were increased by the lateral or longitudinal forces due to the action of the crane were made 25 per cent greater than the allowable unit stress in the members not affected by this loading.

To Start Illinois Waterway

As the first step in the construction by the State of Illinois of the waterway to connect the Chicago drainage canal with the Illinois River, the State Department of Public Works has invited proposals for the Marseilles lock in the Illinois River. This waterway will be the closing link in a navigable route between the Great Lakes and the Mississippi River, as noted in *Engineering News-Record* of Feb. 26, 1920, p. 433.

Experience With Automatic Crest Gates of Wissota Dam in Flood

A SUDDEN rise in the Chippewa River during the last week in March, causing considerable damage to dams above Eau Claire, Wis., was due to melting snow and to heavy rains falling on a territory covered with snow and ice. As a rule the ice on ponds and rivers is rotten before the floods come and is washed out. This flood appears to have started with an ice jam which carried away the old timber Dietz dam on the Thornapple River, in Sawyer County. It increased rapidly, carried out several Tainter gates at the Cornell dam and the walk and flashboards of the Dells dam, just above Eau Claire.

At the Wissota dam, three miles above Chippewa Falls, Wis., the pond had been lowered about 8 ft. below normal early in March to obtain additional power, but it was filled during the first stages of the flood and as the peak was approached the water rose nearly 3 ft. above its normal level. A head of 60 ft. is carried by this dam, flood water being passed over the spillway by 13 Stauwerke automatic gates 60 ft. long (see *Engineering Record* of Jan. 29, 1916, p. 137). These gates are designed to hold the water at El. 898, but a level higher than El. 900 was reached, as shown by the accompanying table.

WATER ELEVATIONS AT WISOTA DAM DURING FLOOD OF MARCH, 1920 (Readings at 6 p. m.)

Date March	Pond Level	Tail Level	Date March	Pond Level	Tail Level
20	890.7	837.4	26	899.5	850.
21	892.2	837.3	27	900.4	852.0
22	893.5	839.0	28	900.1	852.6
23	895.4	840.5	29	899.2	851.1
24	899.5	841.5	30	899.9	849.3
25	898.7	848.0			

Normal elevation, 898.
Maximum elevation at crest of flood, 900.5.

An automatic recording gage station is maintained at Chippewa Falls, three miles below the dam, by the Railroad Commission of Wisconsin and the U. S. Geological Survey. According to a report by the Railroad Commission the record shows that the gates did not release any large volume of water until the pond elevation had reached 900, or two feet above normal. They then operated to lower the pond about 1 ft., but as the flood increased they held back the water until the pond elevation was 900.5 at the time the crest passed. The following is quoted from the report:

> After the Stauwerke gates had been operating for about a year at Wissota, a test was made by order of the Railroad Commission to determine their operating qualities. It was found that the gates did not drop to waste the water until it had reached a point several inches above the normal level. Also that after they had dropped sufficiently to waste the water they did not return to position until the water had gone down several inches below normal. The conclusion at that time was that while their operation was satisfactory with respect to safety to the public, which was the only question involved in that investigation, the indications were that they lacked sensitiveness. There was a range of perhaps a foot or more between the level at which they would drop and the level at which they would rise to position. This sensitiveness is somewhat unfortunate from an operating point of view as a great deal of valuable water is wasted.

The Stauwerke automatic gate does not lend itself so readily to flood control as do ordinary Tainter gates. There is no means of draining the pond in anticipation of the arrival of a large volume of water, even when it is known that a flood of large proportions is approaching. In the flood above described, approximately 80,000 cu.ft. per sec. were passing down the river and these gates could have handled a larger quantity of water, but had it been possible to waste water faster in the earlier stages, perhaps a smaller maximum would have resulted at Eau Claire.

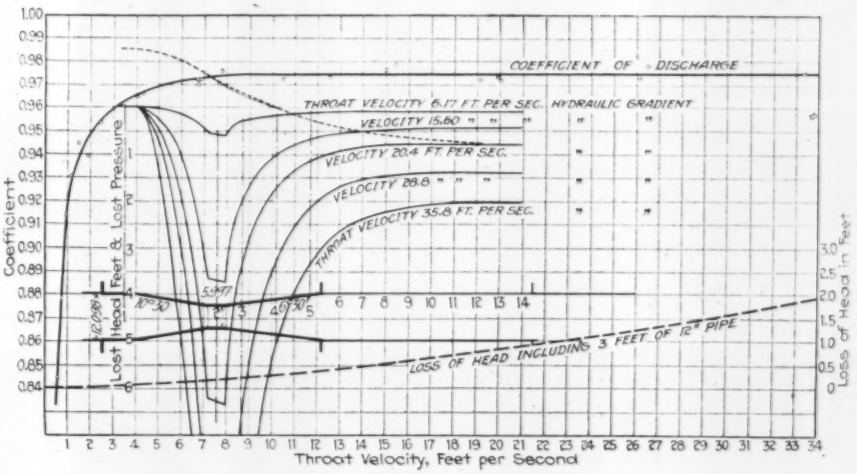
Test Curves of Special Venturi Meter Agree with Theory

By W. S. Pardoe
Assistant Professor of Civil Engineering, University of Pennsylvania, Philadelphia

THE accompanying curves of the test of a 12 x 6-in. special Venturi Meter show, in the coefficient of discharge curve, a very substantial agreement with the computed curve for this sized meter shown in an article by the writer in *Engineering-News-Record*, Sept. 25, 1919, p. 606.

On the same curve sheet are plotted a number of hydraulic gradients for various velocities obtained from piezometric reading at piezometers 1 to 14. The form of these curves is well illustrated and also the fact that the recovery of pressure continues after the downstream end of the discharge cone for a length of three diameters. This meter is special in that the downstream half angle is 6 deg. 30 min. instead of 2 deg. 30 min. as is usually the case.

The loss-of-head curve at the bottom of the sheet shows that if three diameters of straight pipe be included with the meter the loss of head is closely given by the expression $h_1 = 0.0017\ V_t^2$, which is very nearly the same as for meters of this size with the downstream half angle 2 deg. 30 min. The economy in the length of the meter is very evident as shown by these curves of actual test.


COEFFICIENT OF DISCHARGE
THROAT VELOCITY 6.17 FT. PER SEC. HYDRAULIC GRADIENT
VELOCITY 15.60 " " " " "
VELOCITY 20.4 FT. PER SEC. " "
VELOCITY 28.8 " " " " "
THROAT VELOCITY 35.8 FT. PER SEC. " "
LOSS OF HEAD INCLUDING 3 FEET OF 12" PIPE
Coefficient
Lost Head & Lost Pressure
Loss of Head in Feet
Throat Velocity, Feet per Second

CURVES FROM TEST OF SPECIAL VENTURI METER MADE AT UNIVERSITY OF PENNSYLVANIA

Board of Review Justifies War Construction Methods

Two Engineers and One Accountant Appointed by Assistant Secretary of War After a Long Investigation Make Some Recommendations for Future Emergencies

IN THE summer of 1918, Benedict Crowell, Assistant Secretary of War, asked three civilians, two of them engineers and one an accountant, and all men of the highest prominence in their respective professions, to "review the construction work rendered necessary by the war emergency and done by or under any subdivision of the War Department." The investigation was to be made "particularly to cover the methods, procedure and results of the Construction Division of the Army." The Board first met Sept. 11, 1918, and immediately started work. It rendered a preliminary report just after the armistice and a final report Aug. 31, 1919. This final report has just been issued by the Government as a printed book of 381 pp., which constitutes one of the most important contributions to the history of the engineering of the war, as well as an interesting comment by experts on a subject on which unexpert and partisan congressmen have been unusually verbose in this presidential year.

The board was composed of Francis Blossom, of the firm of Sanderson & Porter, Engineers, chairman; Charles A. Morse, chief engineer of the Rock Island Ry. and assistant director of operation, engineering and maintenance, United States Railway Administration, and W. Sanders Davies, public accountant, and president of the American Institute of Accountants. Thomas H. Pierson was assistant to the Board and in charge of the Washington office.

The report is long and involved. The board had full authority to require all available information from any of the agencies of the War Department and it apparently did so. Its conclusions are given in repetitive detail, with successive abstracts of the main deductions. They all reduce to a comprehensive endorsement of the War Department's policy and practice and especially of the cost-plus contract as used by the Construction Division. There are some recommendations for the future which differ from the practice of the past, but they are the results of experience and in the eyes of the board could not necessarily have been foreseen. The board is strong in condemnation of the lack of preparedness of the country which forced the terrific scramble of the summer of 1917, but on the whole agrees that the construction work on this side of the ocean—it did not look into the work of the A. E. F.—was remarkably well done.

As a byproduct of its investigation, the Board comes out strongly for a Department of Public Works—though not under any specific name—which will include even the construction work of the army. It also commends the decision to vest the construction work in the Cantonment, later the Construction Division, and not to give it over to the Corps of Engineers.

Abstract of the conclusions of the report are given below:

The Board of Review found little evidence of dishonesty in War Department construction work. It believes that the greatest losses to the Government were not due to dishonesty, but were caused by the use of inadequate methods and men who were unfit or incompetent for construction tasks put upon them. The giving of important positions to men who were untrained in the work they had to direct was costly and jeopardized the success of the war program. It may have been thought that such men would be less apt to use their positions to overdue their work or to profit by contracts placed with their former associates, overlooking the fact that incompetency of officials invites dishonesty, because of their inferior capacity to direct or stop it. Whatever the reason, vacillation and inaction were assured while such men were learning their tasks. No method more costly or more likely to cripple the work of the Army could be adopted, as the extra costs of a prolonging of the war by delays due to inefficiency of this kind could easily run into hundreds of millions of dollars and thousands of lives.

Political influence was not a disturbing factor in war emergency construction work, and there is a good ground for belief that it would not prove detrimental to the peace-time operations of a consolidated construction bureau handling all ordinary Government work.

As to the plan: It would have been impossible for the Government to build the cantonments and camps on time by purchasing materials and employing its own labor forces. Results proved that the Government had all and more than it could do to expand its own staff bureaus to meet war demands without simultaneously attempting to create and operate a large number of construction organizations.

Engineering—The method generally adopted of making only the typical plans in Washington was the only one under which the field work could have been done within the available time. The standards adopted were from the best engineering practice and could be applied to construction work without waste of time or money on non-essential details. In many cases decisions had to be made without precedent. This necessitated knowledge, judgment, and experience. Energy and boldness were shown by the engineers in quickly conceiving the plans and in accomplishing their prompt execution.

Construction—The placing of competent men in charge of each project and giving them broad general instructions and full authority over the work, the selecting of experienced contractors, and the giving to superintendents and contractors the assistance of expert advisory engineers and town planners was in line with the general policy for emergency construction work approved by the Government.

Many difficulties were met in organizing administration and construction forces of the necessary size. There were no contracting organizations of sufficient size to undertake the work that was planned, and, as those used were organized under the stress of war-time conditions, it was difficult to obtain efficiency. This organizing entailed some lost motion, but, considering the work as a whole, the efficiency was apparently no lower than might reasonably have been expected from the prevailing conditions.

Material—The methods adopted for locating and purchasing, or otherwise acquiring, all the needed materials proved effective. The procurement of some of these materials in quantity, through the medium of representatives of groups of manufacturers in Washington, was advantageous from the standpoint of speed. It distributed orders according to the existing facilities for filling them and prevented confusion and congestion in the material markets, which would have delayed deliveries. It is believed that the prices obtained by this substitution of co-operation for competition were as low as could otherwise have been obtained.

Quality of Construction—The board has studied cantonment plans and specifications and inspected the type and quality of construction used in a number of these projects. Its conclusions thereon are as follows:

All facilities that were important and reasonably warranted were furnished.

The general health, comfort, and convenience, and the

physical, mental, and social welfare of the troops were provided for as fully as was practicable.

The barracks were of modern housing type, reasonably well provided with ventilation, window screens, heat, and electric light.

An adequate supply of pure water was furnished for drinking and bathing, with modern plumbing and sewerage systems.

The kitchen, bakery, and steam laundry equipment were first class.

Facilities furnished for reading, recreation, amusement, and comfort included libraries, theaters, and post exchanges.

The civic improvements equaled, in character, those of many suburban cities and included walks, paved roads, street lighting, and fire protection. In some cantonments the buildings were painted. This added to the life and decidedly improved the appearance of the structures.

Speed of Construction—This board shares the generally expressed opinion that the cantonments and camps were built with remarkable speed.

The designs were as economical as the requirements and as due provision for the health and reasonable comfort of the troops permitted.

Delays occurred due to lack of competent workmen and mechanics. Some loss of time was caused by lack of proper supervision of labor. Most of the delays were due to unavoidable causes and emergency conditions, and all were so overcome that the construction was ready as and when needed.

In reviewing war results obtained and difficulties overcome by the industrial home army or the overseas combatant army, the essential test is believed to be the degree of success achieved and not the size of the organization or of its pay roll. In order to have the necessary workmen for this construction on hand when needed it was impossible to avoid having and paying for labor surplus when progress was slowed up by lack of materials or other causes. The board believes that, in a review of the cantonment and camp work done in 1917, for the tests of speed, quality, and cost must be substituted speed and quality.

The reported total cost of the 16 National Army cantonments and camps as of December 31, 1918, was somewhat under $200,000,000 and the average daily cost of the war to the United States was about $30,000,000. If the completion of these cantonments and camps in time to receive the army in September, 1917, and to house it during the extreme winter of 1917-18 shortened the war by only one week their total cost was saved. If it shortened the war by one or two days the total excess cost paid for speed were saved. These figures include no allowance for any saving of soldiers' lives.

The board is of the opinion that, had construction not been pushed at maximum speed, cold weather would have interfered with and caused much delay in this housing work, which, with the difficulty of training troops in severe winter weather, would have greatly delayed the mobilization, training, and embarkation of American troops for France, with results that might have seriously influenced the issue of the war.

The work of this organization was greatly aided by the good teamwork and spirit of co-operation which was built up within it by its leaders. Special mention is due of the broad vision, knowledge of character, and good judgment shown by these men in the selection and placing of their subordinates.

The conclusion of the Board of Review is that the value of the method and results used on cantonment and camp construction can not be measured in dollars or in unit costs but must largely be gaged by the usual test of army work, success or failure. In this case all evidence obtained indicates that they achieved a degree of success much beyond that anticipated.

The Construction Division of the army earned the respect and confidence of substantially all of those with and for whom it worked, especially as to its grasp of actual and probable requirements and its sped of execution. The plan of organization, methods and procedure, taken as a whole, and measured by results accomplished, seem to average higher than those of any other War Department bureau with which the board has dealt, and it can suggest no improvements therein except for certain minor changes, largely in accounting procedure, which could be made to advantage if the division were given additional authority or a military position higher than its divisional status. Its present plan of operations provides properly for centralization of advisory and directing functions, decentralization of supervisory and executive functions, and expansion to meet construction requirements of almost any character.

Its personnel showed unusual ability, energy, and courage in grappling with the big problems of design, administration, and construction which were thrown upon them and demonstrated capacity and competency to handle such work satisfactorily. The standards and methods adopted in the selection of its personnel and the character of men chosen reflect credit upon the the chief of the division and his advisers. They showed discrimination in the choice of officers, took special pains to put the right man in the right place, where he could work at maximum efficiency, and, in order to eliminate guesswork and selection based on impressions, endeavored to choose only men who had made good and to put them on a class of work with which they were familiar.

The division was itself responsible for creating its present plans of organization and operation. It developed a high order of teamwork by the use of picked men having experience, enthusiasm, and self-confidence, who seem to have been singularly free from pessimism and jealousies, handled work more by mutual suggestion and patriotic self-subordination than through orders and the exercise of authority, and realized their responsibility for promptly supplying the structures and plant facilities essential to the production work of other war bureaus. These men showed zeal, ability, and results of the highest order and were tireless in their efforts to create such a non-combatant army of workers as would ensure the quick construction of all facilities required to maintain an uninterrupted flow of supplies to the Expeditionary Forces.

The Board of Review is of the belief that this work was done at a cost which was greatly increased by national unpreparedness, but which could not have been lessened by placing the work with any other military or civilian bureau.

The Board of Review is of the opinion that the Construction Division should not be disbanded after the accomplishment of its specific war work, but should be utilized to co-ordinate and handle army construction and related work in peace times and that the Government can further its interests in no more effective way than by continuing and extending the consolidation of its construction work.

The board is convinced that the functions of design, construction, and procurement of materials should, together with authority, responsibility, and accountability, be placed with one division, corps, or department; that it should perform all non-technical War Department and Government construction work; and that such division or agency should, when necessary, co-operate with other Government agencies in the clearance and allocation of projects and of the material and labor therefor.

The fees paid to supervising engineers, except on a few projects, and the salaries paid to their assistants were very small in comparison with the responsibilities involved and the fees commonly paid for similar services on private work.

The Board of Review is of the opinion that the correctness of the decision to place this work (other bureau and corps construction) with the Construction Division and to have it act under the Secretary of War and co-operate with the War Industries Board has been proven by the successful results of such method, particularly in obtaining the speed essential to meeting army needs.

The Board of Review * * * finds that the Secretary of War acted wisely in disapproving the recommended transfer of the Construction Division to the Engineer Corps

under war conditions and is further of the opinion that the transfer should not be made under peace conditions and that the Construction Division should be entirely separated from the Quartermaster Corps.

It is the belief of the Board of Review that the Cantonment Division was better equipped than the Engineer Corps by professional and commercial acquaintance, training, and experience to deal quickly and effectively with the contracting, industrial, and labor interests which had to be relied upon to execute this work; also that the use, on the cantonment and camp construction, and on the later construction work of the War Department, of commissioned civilian engineers and constructors rather than the regular army organization, and the use of other civilian engineers who worked as Government advisers and employees and contractors, released for overseas combat service the limited number of army officers who had military training and allowed the work to be done by the men best qualified to handle it.

Cost-Plus Contract for Emergency Work

The Board of Review has made special inquiry of many contractors, constructing, and administrative officers, field auditors, advisory and supervising engineers, and other competent judges respecting the methods and procedure used and results secured on construction done under the Contract for Emergency Work. The following statement summarizes the more important opinion so obtained.

1. The contract permitted starting work promptly and pushing it rapidly. This prevented loss of time, which meant loss of money and lives and possibly of the war. The speed attained under the contract was responsible for getting troops to France in time to turn the tide which many believed had to be turned in 1918, if at all.

2. The contract could be used without change, irrespective of the size or character of the project.

3. Delay was not necessarily entailed by the frequent lack of definiteness as to general requirements or as to total structures and facilities to be provided.

4. Work could be shut down or rushed to completion at the discretion of the Government.

5. Prices of materials and labor and the quality of the work could be fixed and controlled by the Government, and disputes were avoided as to these and were largely eliminated as to overhead costs and extras.

6. The contract was unaffected by wide variations constantly occurring in the available supplies of material and labor.

7. Loss of time through the creation of new construction organizations was avoided by the selection and utilization of such existing contracting concerns as were best qualified to execute the work.

8. The contractors, subcontractors, superintendents, engineers, and Government representatives on the various projects were all working with a common interest and to the same end—to finish the work in the least time and at the lowest practicable cost under the conditions prevailing.

The board concurs in the foregoing opinions and conclusions:

The schedule of fees provided in the standard contract seems, in the opinion of practically all who were interviewed, to be generally considered as adequate and fair to all parties. The Board of Review shares this view and, had the war continued, would have suggested no material changes therein. The board has also considered the question as to whether contractors should be selected according to their willingness to do the work for less than these fees. Many such contractors could have been found. The board is convinced that such a plan, if adopted, would have proved disastrous to the execution of the war program and that an effort to save on the fee of a competent contractor by selecting another because of his willingness to work for a smaller fee would have been as false economy as to attempt to hire legal, medical, or other professional service on such a basis. Savings in fees so effected would have been wasted several times over in other ways and would also have entailed fatal delays.

The board finds that the standard contract secured maximum speed, coupled with proper quality, at a less relative cost than could have been done by any other method available and that it operated with smoothness and flexibility and prevented delays from misunderstanding and friction between the Government and its many contractors. As a rule its critics do not seem to have grasped the underlying facts and conditions nor always to have understood the nature of the contract and the reasons for its adoption. No form of war emergency construction contract could eliminate waste, extravagance, or inefficiency which, under war conditions, could only be minimized through the use of experienced Government representatives on the work of administration and supervision, and competent contractors on the work of execution.

The board finds that the use of this form of contract, as finally developed, was well justified and contributed to the success of the emergency construction program; that by its use speed was attained in war construction projects; and that it is probable that such work could not have been performed in the time available without it or its equivalent.

The board finds that the cost plus with sliding scale and fixed maximum fee contract can not be judged alone by the cost of work done thereunder as it was designed primarily to, and did, secure speed; that unit labor costs thereunder were high, as in all war work, but that the causes did not lie in the contract itself, but rather in the conditions surrounding its application, which were principally high wage scales; overtime; use of any labor obtainable to push work; inefficiency for floating labor; labor shortage; lack of experienced foremen and superintendents; and poor management by some contractors.

The Board of Review is, however, of the opinion that in the matter of fees the standard contract could have been simplified by the use of a block system of fees based on the payment of a fixed amount for the first block of the cost and of suitable additional amounts for each additional block; and that under such a block system of fees a concern proven satisfactory on emergency construction could probably have been kept at work continuously throughout the war period for a lesser total fee than by subdividing the same work among several contracts executed with him or others.

The board is also of the opinion that Government interests would have been helped in some cases by the insertion of a clause in the standard contract requiring that the duly appointed representative of the general contractor or subcontractor who, under the contract, was to be kept at the site, be one of the chief executives of the corporation or a member of the firm. Much work had to proceed on general plans while details were being developed and this involved decisions respecting locations, roads, transportation, handling of materials, etc., which required that the contractor's resident executive be a man of large caliber. The insertion of the provision mentioned would have enabled the Government to compel a negligent contractor to give the work the needed quality of supervision. In some instances the contractor tendered his organization and invited the constructing officer to use it. This attitude threw responsibility and duties upon the latter which the contractor alone should have carried.

Suggested Contract Improvements

The Board of Review has condensed some of its views and conclusions into the following suggestions for improvements:

Have all Government agencies use types of standard construction contracts so far as possible.

Adopt the standard form of Contract for Emergency Work when conditions make it advisable that Government construction be done on a cost-plus basis, as this form of cost-plus contract created by the General Munitions Board and used by the Construction Division of the army was of great value in accomplishing the war emergency work.

Create by a qualified board or committee corresponding standard forms of lump-sum and unit-price construction contracts for ordinary peace-time use.

Prohibit the use of multiplicity of construction contract forms varying widely and unnecessarily in type, form, and compensation of which many instances may be found among Ordnance contracts.

By adopting contract standards such as those above mentioned, the Government will be better protected and will save time and money and the contractors will receive fair and uniform treatment and the amount which the Government has to pay for its construction will not depend upon the experience of its Government representative who is charged with the negotiation or be controlled by patents or by the special trade or professional knowledge of the contractor. Any compensation properly due him for these features should be specific and not be used as a basis of bargaining as to the fee to be paid for the construction of the needed plant facilities.

Consolidation of Government Construction

With respect to these and related matters the board is of the opinion:

That as, under peace conditions, and to a large extent under war conditions also, nearly all construction and the engineering incidental thereto is of a civil character, the principal exception in each instance being that which relates to artillery and combat work, civilian engineers and experts must constitute the main reliance of the country for the construction work of both peace and war.

That as time does not permit including thorough and varied training in practical commercial work in the education of army engineer officers they will be outclassed by civilian engineers on most construction work, but should, nevertheless, be given as much of such training as possible because they will otherwise become a clog instead of a help to those whom they may be called upon to direct but whose work and problems they can not properly understand without it.

That, so far as practicable, the directing and executive engineers on most Government construction should be drawn from civilian life, be unhampered in their work by differences of military rank and stand on peace and not a military or war basis as to classification and relationships.

That, if the organization handling the nation's connational construction and engineering work that civilians can do, because, in another war, its engineers will again be unable to handle such home work in addition to their military work and that the practical training given to army engineers in peace time should be provided by detailing them to work on construction on a parity with civilians, as any plan which gives them the special status of military rank on construction work will prove unsatisfactory because army rank tends to insulate them from the most educational features of the work.

That, if the organization handling the nation's construction in times of peace were directed by the War Department, it would in time of war be disrupted by the calling of its chiefs into active service at the very time it was most urgently needed for war-emergency work.

The board is impressed with the benefits which were secured by consolidating the construction work of various War Department bureaus and believes that much other Government construction could be merged to advantage and that national preparedness for peace or war would be effectively promoted by creating a Federal construction bureau with an essential civilian organization and personnel to administer and supervise all Government construction except that of a technical military character. Such a bureau could handle more expeditiously and economically than the War Department many construction problems which, in the past, have been loaded on to the latter, which can not be made an efficient peace-time administrative-construction bureau because its functions are essentially military and its operations are hampered by complications of military organization and rank inseparable from army activities. The projects of such a construction bureau would afford better opportunities for the practical education of army officers, and cost the Government much less than the present plan of placing much of such work under the War Department. All of the principal national engineering societies advocate the formation of a construction bureau of the character above described.

To handle properly a large volume of Government construction work control must be exercised through centralized supervision. This should fix the general standards and policies and be decentralized as to the design and execution of individual projects, so permitting the proper adaptation of general plans to local conditions by those in direct charge of each piece of work.

The War Department alone should not be relied upon and made responsible for the success of the army in war. In peace times its status is necessarily one of inaction and such an organization, normally inert, can not of itself expand speedily to the full proportions necessary for meeting all army needs in a war emergency and assure the country of protection. In time of war the War Department is expanded under great strain from a relatively small to the largest Government department. At such times other departments, particularly those having to do with internal affairs, are contracted and many of their activities practically suspended. As the Government has to utilize civilians to perform its construction work during war it is desirable to relieve the War Department from dangerous strain in war by having a peace-time construction organization which, being unhampered by military regulations, could work at maximum efficiency and in war could handle emergency construction speedily and effectively. A sufficient amount and variety of work to keep its personnel well trained would be provided under such a plan without enlarging the normal and proper scope of Federal activities.

Observation indicates that satisfactory results in the war emergency construction have been accomplished largely by, and in degree proportionate to, the freeing of experienced constructors from control by Army officers. This leads to the conclusion that neither Military Academy training nor Army experience can of itself insure fitness or ability to handle construction work.

After full consideration the Board of Review finds that Government construction work for public use should not be done by the War Department and that the execution of some of the construction now assigned by law to that department should be transferred to a civilian construction bureau.

Officers' Reserve Corps

The Board of Review is of the opinion that the Officers' Reserve Corps members engaged on the emergency-construction work of the War Department could have rendered better service if the time available for their training had permitted giving them more instruction in Army-organization methods, relations and discipline, as many civilians, especially the older ones, entering the Army do not seem to grasp the need of conforming to its requirements. There also seems to be considerable room for improvement on the part of the officers of the Reserve Corps and those of the Regular Army, who represent respectively the civilian and military branches of engineering, in developing adaptability to the other's viewpoint.

Locating a Railroad by Airplane

According to a recent "news letter" of the Air Service, United States Army, locating a railroad by airplane has been carried out by the Third Aero Squadron, Camp Stotsenburg, Philippine Islands, and one long flight has enabled a railroad engineer to determine which one of three general routes will be used for the new road. It is stated that many months and thousands of dollars have been saved in the work. Instead of three parties of locating engineers being sent out to make the survey, only one will now be necessary. The new line is projected by the Manila Railroad Co. as an extension of its line from Cabanatuan through parts of the provinces of Nueva Ecija and Nueva Vizcaya to Bayombong. The first trip was made with the chief engineer of the railroad, passing over Mount Arayet and then following the Pampanga River until the railroad line was picked up at Gapan. The river was followed from Cabanatuan on to Pantabangan and over Mt. Pangloriahan, thence to Bayombong.

Extending Benefits Assessments to Street Railways

Electric Railway Commission Urges That Property Benefited Stand Part of Cost of Street Railway and Subway Extensions

BASING their argument upon the well-known theory and practice of assessments for benefits as an equitable means of financing streets and sewer improvements and pleading that landowners as well as street-car riders should bear part of cost of the electric railways service, the Federal Electric Railway Commission, in its recent report, urges that wherever practicable some or all of the cost of street railway extensions, subways and elevated railways be assessed upon the owners of the property benefited. By way of illustration it summarizes estimates made by the City Club of New York in 1906, showing that a subway extension costing $7,375,000 increased the value of the property in the district benefited by $49,200,000, or nearly seven times. Commenting on these figures and then elaborating its argument the commission says:

Is it not in accordance with the laws of economic justice, then, that the landowners, as such, should share the benefit of increased land values with the public? Instead of the cost, $7,375,000, of the Manhattan extension being borne by the owners of land in the newly served territory, it was capitalized and translated into an annual charge of $350,000 or more, a burden which had to be borne out of the car fares and which today helps to intensify the financial predicament in which the company finds itself. If the public pays out of its fares for the cost of maintaining and operating the line which will bring the outlying land owners such enrichment, should the latter not share with the public out of that enrichment, depending upon the degree in which he is benefited, by paying for or by helping to pay for the initial cost of construction of the line? That such a solution is just is rather significantly shown by the fact that in a number of cities land owners in outlying districts have offered spontaneously to contribute large sums to the company to assist it in constructing certain extensions.

The present predicament of the street railway companies is in many places partly due to overbuilding, a fault traceable to political or business pressures exerted by speculators in suburban lands who had little or no financial responsibility in connection with the street railway extensions which they caused to be built for their immediate benefit. This action of the suburban land owners of certain cities, on the other hand, is a significant expression of enlightened self-interest and a sound, constructive recognition of a fundamental principle of justice. The establishment of that principle by law, whether by changes in city ordinances, state statutes or state constitution, should, in our opinion, not be delayed. This thought is especially recommended to the attention of a number of communities which are now facing the necessity of extensions or rapid transit improvement.

Three points in this connection should be briefly touched upon: (1) The amount of the assessment on any owner would probably have to become fixed by an appraisal some time after the construction of the improvement, and the owner should be given the option of paying his assessment in installments over a course of years. Consequently, the actual first financing of the extension might have to be by the city. (2) It will doubtless be urged by some that such a system for building extensions would lead to municipal ownership. On the contrary, it seems to us that, if properly administered, it could, by reducing the acuteness of the fare question, serve with much force to offset the pressure for municipal ownership. (3) As to the problems incident to allowing a private company, for a nominal rent and in return for undertakings as to repair and maintenance, to take over or use public property, similar problems incident to similar arrangements have already been ably and effectively handled in Boston and a number of other cities under state or municipal regulation in connection with subways and other structures.

The Commission then takes up some of the broader aspects of the subject, including the relations of the street railway and rapid transit to city planning the housing problem and social welfare and concludes by urging that the plan, notwithstanding legal obstacles, be given a trial:

If objection to the employment of such principles in constructing extensions be made upon the ground that public officers and land owners along the line of the proposed extension are thus given the power to vote such extension, let it be remembered that the problem of extensions is not only a serious financial problem, but is also esesntially and finally a long-range social problem. The development of a city's street railways should be guided primarily not by the fortuitous financial experiences of a small group of bankers or real estate operators. It should be guided by the foresight and vision of those who are officially responsible for planning the city's growth and life, in terms of its water supply, its light, its streets, its sewers, its schools, its parks, its playgrounds, its civic centers, its night amusements, its community life, its libraries, its hospitals. It should be guided by those whose public duty it is to be interested in the health and happiness of the average city toiler and his family of growing children.

The call for municipal ownership today does not all emanate from dissatisfaction with the service in a narrow sense as riding facilities. It is largely an expression of feeling on the part of many that the street railway, instead of helping to make conditions bearable, is contributing to making them unbearable; that it is not, with the functions and powers which it exercises, accomplishing what it might accomplish to reduce the abnormalities of city life. While areas within the city remain undeveloped and unserved by adequate transportation, toiling thousands find themselves dragged out miles further—not to green lawns and spaces, but to a repetition of the same ugly congestion that they knew in the city. The time will come when employers and educators will be forced to take cognizance of the impairment in working efficiency caused by such inconveniences as are suffered by the traveling public today. The time is approaching when cities will find it necessary to extend their street railways, not on the basis of new property values or the earnings of any single line of rails, but on the basis primarily of what will be most consistent with the public health and public economy.

These motives are strongly at work underneath our situation today. The public's control over stock issues, service, routes, extensions, etc., is needed today not only in order that as part of a plan for restoring the credit of the street railways the community's interest may be protected by the guarantee of efficient management, but also because the city of today is taking a more conscious, constructive interest in the city of tomorrow. That interest can be recognized and cared for under private operation if the public authorities have the suggested control. If such control does not come into effective existence, then one of the strongest forces making for municipal ownership will continue to exert an increasing influence.

Your commission trusts that this principle of paying wholly or in part for the construction of extensions out of special taxation of benefited property will be seriously studied and adopted, where possible. It seems fundamentally sound. While its adoption presents legal difficulties, as has the adoption of many another newly recognized industrial-economic relation, it holds great promise for reducing the financial problems incident to public transportation.

The entire body of conclusions and recommendations of the commission's report, with editorial comment, appeared in this journal, Sept. 2, pp. 480 and 436.

Monolithic Brick Pavement Fails From Expansion

Heat Causes Brick Slab To Separate From Concrete Base and Finally To Rupture With Violence

By M. W. Watson
State Highway Engineer, Topeka, Kan.

DOUBT as to the suitability of monolithic brick pavement for Kansas is raised by the behavior of the first rural road of this type constructed in that state. Explosions of the brick surface have called for a number of repairs to a road only a year old. Showing generally a good joint bond, the brick top bulged up from the concrete base and finally the surface was broken and forcibly dislodged. Improved methods of construction may be able to eliminate the danger, but until their efficacy is demonstrated it is thought that the adoption of monolithic brick for Kansas highways may well proceed with caution.

Between the cantonment at Fort Riley and Junction City there was a pre-war waterbound macadam road 30 ft. wide which soon succumbed under a war-time traffic of 8,000 vehicles a day. It was thought that a 20-ft. monolithic brick pavement, properly constructed, would withstand this traffic and in the autumn of 1918 its construction was begun. The work was designated Federal-Aid Project 12. Delay in procuring materials greatly prolonged the construction, but the urgency of the improvement made it necessary to proceed even at low temperatures and, therefore, the contractor was frequently obliged to protect the pavement from freezing.

Large trees border both sides of the road and its surface is constantly shaded. The grade is practically level. Ample drainage is provided for surface water but it was not practicable to elevate the road entirely above flood overflow. The cross-section, Fig. 1, shows

FIG. 1. SECTION OF PAVEMENT FRACTURED BY HEAT

the design. The old macadam was carefully reshaped and rerolled to form a substantial and uniform sub-base. Having this rigid sub-base, the slab was designed only slightly thicker than is general practice for concrete pavement.

A 1:3:5 concrete was used for the base. The stone, which was graded from ¼ in. to 1½ in., had a French coefficient of wear of three and a toughness of approximately five. Mortar briquettes made with sand pumped from the adjacent Republican River, showed 4.4 per cent greater strength than briquettes made of the same cement and standard Ottawa sand. Vertical fiber brick 3 x 4 x 8½ in. were laid with the rough wire cut surfaces at top and bottom. To give grout space, the brick had grooves on one side aggregating about 30 per cent of the surface area. Lug bricks were not then made by local plants.

Steel forms and a multiple steel templet were employed for placing the base concrete and the 1:3 dry mortar cushion. The brick were laid directly on the mortar bed and after culling were rolled with a light hand roller. Occasional bricks, lifted after rolling, showed that the dry mortar had become sufficiently damp to adhere to their bottoms. A grout mixing machine was employed and great care was taken to make certain that the grout penetrated to the bottoms of the joints.

Service observations of the pavement are for the year 1919. As far as can be seen the effect of traffic has been slight; the surplus grout is not worn away. Transverse cracks have developed about every 60 ft. and approximately 400 ft. from one end there is a longitudinal crack about 250 ft. long. None of these cracks show signs of wear.

Construction was completed late in December, 1918, and in the early spring of 1919, when the temperature reached a fairly high level, an explosion occurred at

FIG. 2. SHATTERED PAVEMENT AFTER FAILURE

about midlength of the project. For a space of about 12 ft. the bricks separated from the base and were scattered promiscuously. During the summer of 1919, four additional explosions occurred in the total length of 1.12 miles. Examinations showed that the grout had penetrated the full depth of the joints. In one instance, when the writer examined the road a short time before the explosion, it was found that the brick slab had lifted from the base for a span of 15 ft. A truck in passing over this bulge caused a variation in height of about 2 in.

The view, Fig. 2, shows a damaged section of pavement after failure. Brick taken up when failure had occurred, as is indicated by Fig. 3, disclosed very little adhesion to the base but the grout joints remained intact in several rows. The bricks were not shattered nor crushed, but were sometimes broken in the middle. In two cases the base remained intact, indicating a complete separation and a probable greater stress in the surface than in the base. The failures occurred at different points along the road; some at construction joints and some between construction joints; some in the shade and some in the sun.

It is evident that a monolithic brick pavement should not be built at low temperature, without expansion joints, as the materials become fixed in place when contracted and the resultant expansion on raising the temperature is fatal. The use of expansion joints at frequent intervals might serve as a preventive, but their use in monolithic brick is hardly practicable and if used the true monolithic character of the pavement is somewhat abridged.

To repair the breaks the base was cleaned of all surplus material and the sand cement cushion was removed.

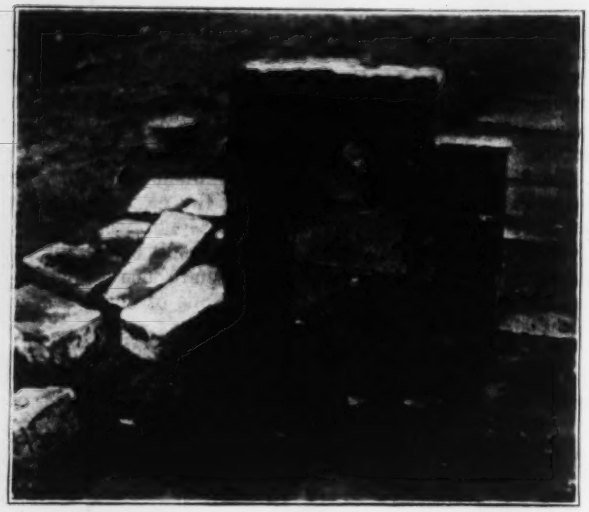


FIG. 3. JOINTS INTACT BUT SLAB BOND POOR

Where a failure in the base occurred, the base was replaced. A row of bricks was laid along each edge, set in mortar and grouted, to form a header, with ample room for expansion at the end. A new sand-cement cushion was placed between the headers and clean bricks were laid to fill the gap. These bricks were bituminous filled on the assumption that they would serve as an expansion joint in the event that too great stress again came at the same point.

A study of the action of this pavement leads to a number of conclusions as to the probable action of monolithic brick pavements under similar conditions.

The climatic conditions of Kansas are extreme but compare favorably with a number of the middle western states. The low temperature sometimes reaches 20 deg. F., the high temperature 110 deg. F. in the shade and at least 140 deg. F. on the pavement in the sun. A pavement may be subjected to stresses of extreme violence by sudden changes of temperature when a variation of 40 deg. F. in a few hours is not uncommon. Sufficient experiments have not been made to show just what thickness of slab will withstand the thrusts brought about by changes of temperature. It is apparent that a 3-in. slab of brick, which at points fails to adhere to the concrete base, is not of sufficient thickness, and there is no guarantee attached to monolithic brick work that will insure this adhesion. The use of the tamping template and the omission of the sand-cement cushion may solve the problem, but until it has been satisfactorily demonstrated that a slab of this character will remain in place, the conservative engineer will seriously question the advisability of building a large mileage and will turn to the older and safer methods.

Sand-Lime Brick Production

The sand-lime brick produced in the United States in 1919, according to an estimate made by the United States Geological Survey, Department of the Interior, amounted to 145,000,000 brick, valued at $1,725,000, an increase of 47,000,000 brick and of $841,000 over 1918. The maximum output of sand-lime brick—227,344,000 brick—was made in 1916, but the maximum value was that of 1919.

Flood Protection Project for Council Bluffs

Flashy Hill Stream Overflows Channel Crossing Flat Lands of City—Propose 2½-Mile Diversion for $897,300

AN OPEN channel diverting Indian Creek from its present channel through the city and discharging into the Missouri River near the upper end of Council Bluffs, Iowa, is the method of protection against the floods in this creek which has been recommended in a report to the city authorities by Alvord & Burdick, consulting engineers, Chicago. The city has a population of about 38,000, which is estimated to increase to 100,000 by 1950.

At present the creek flows south through the entire length of the city, as shown by the map, Fig. 1, and

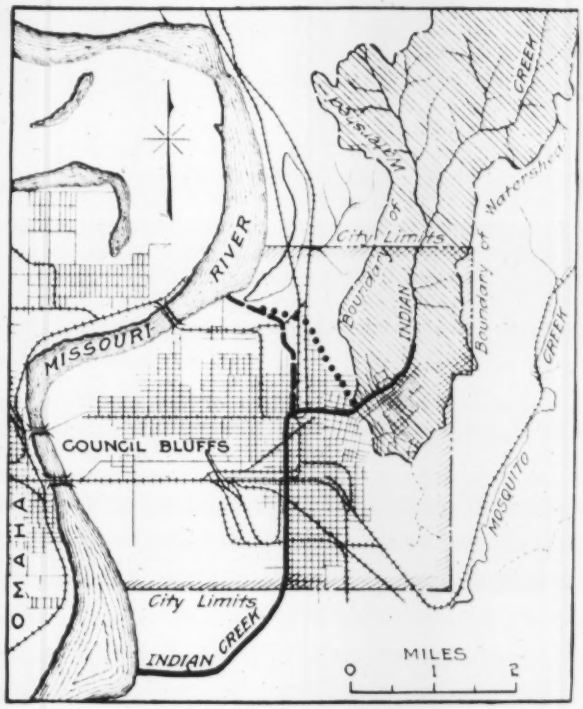


FIG. 1. INDIAN CREEK FLOOD RELIEF PLANS FOR COUNCIL BLUFFS, IOWA

its floods have been a continual source of trouble in an area of about 480 acres comprising business, railway and residence sections. This area has been flooded about a dozen times in the past twenty years. Not only has material loss been sustained by the municipality and the property owners, but the flood hazard has tended to reduce property values and to retard the development of the city. City expenditures for replacing bridges, clearing the channel and removing deposit from streets and alleys after floods have aggregated $412,000 in 36 years or about $11,475 per year. Damage to dwellings, industries and railways is estimated at $22,000 per year, or a total expenditure of $33,475 per year due to floods in Indian Creek.

Although the city lies mainly on the flats or flood

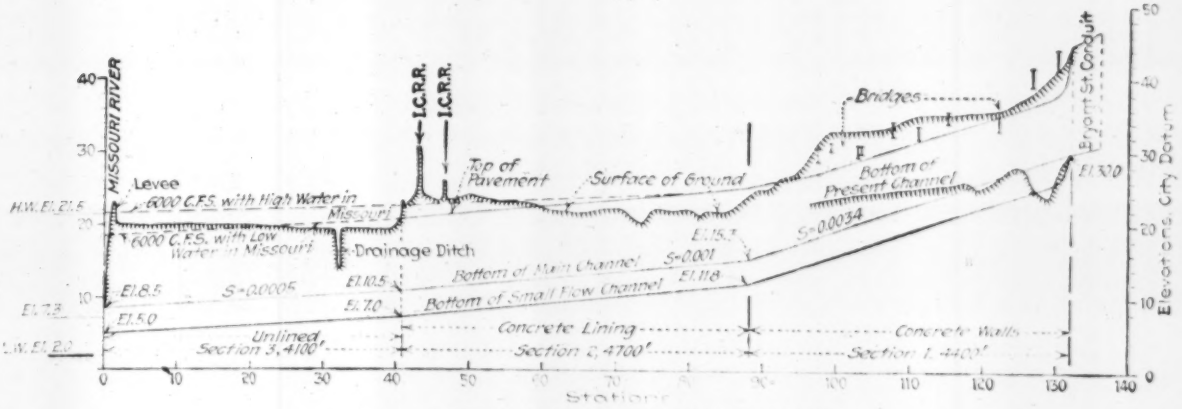


FIG. 2. PROFILE OF CREEK DIVERSION CHANNEL

plain of the Missouri River and has 66 per cent of its area within 10 ft. of the extreme high water level, the heart of the business and residence districts is on higher ground and lies in the path of Indian Creek below Bryant St., at which point it emerges from the hills. Above Bryant St. the creek has a drainage area of 11 square miles and a fall of 270 ft. in 7 miles; but thence to its present discharge at the river it has a fall of only 30 ft. in 5 miles and the slope and cross-sections are insufficient to carry off the floods which originate in the hills. In the flat land the creek does not receive much surface drainage, as its bed is but little below the general level of the ground and its channel lies between artificial banks 10 to 20 ft. high. Below Bryant St. the present channel is crossed by 23 highway bridges and 19 railway bridges.

It is estimated that the greatest floods have reached a rate of 3,500 sec.-ft. and that the channel has a capacity of 5,000 sec.-ft. in the hilly ground above Bryant St. but only 1,200 sec.-ft. in the flat part of the city. In planning protection works it is considered necessary to provide for a maximum flood rate of 6,000 sec.-ft. in view of the future development on the lower part of the Indian Creek drainage area. At present, about 85 per cent of the drainage area is in its natural state or under cultivation, but the report points out that the rate of runoff from a residential district with paved streets and sidewalks will be two or three times as great as that from the present unimproved lands.

Three main projects are discussed in detail in the report. A diversion channel 11,500 ft. long from Bryant St. to the river; the enlargement of the present channel through the city for a distance of 26,550 ft., and a diversion channel 13,200 ft. long from 13th St. to the river. The estimates of cost are $2,046,400, $1,421,000 and $897,300, respectively. A covered conduit would be required for a considerable part of the first plan, ranging from a single channel 15½ ft. deep and 16 ft. wide, to four channels 13 ft. wide and from 9 to 13 ft. deep. Although an open channel would be practicable for the second plan, it would have to be confined between vertical concrete walls for some distance, owing to the high cost of land.

An open channel with sloping sides, partly lined with concrete, can be built on the third route, except that for about 4,000 ft. at the upper end there would be vertical retaining walls. The profile of this recommended channel is shown in Fig. 2. The typical cross-sections, shown in Fig. 3, provide for a wide storm water channel with a central ditch for dry weather flow. The fall per mile is 18 ft. and 8.2 ft. in the two concrete-lined sections and 2.7 ft. in the unlined section, with respective velocities of 19, 12 and 5½ ft. per second. This is equal to the first in point of efficiency and is recommended on account of its much lower cost, which is due to the small number of bridges and the avoidance of expensive

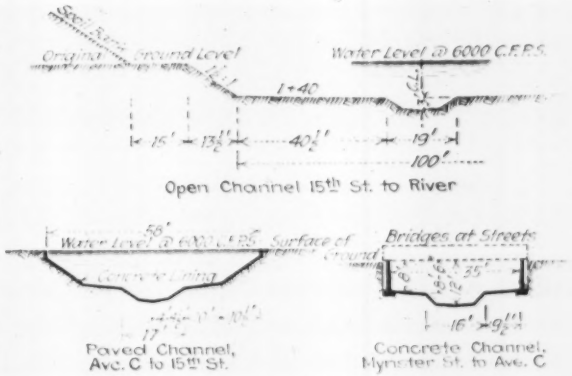

Original Ground Level
Water Level @ 6000 C.F.S.
1:40
Open Channel 15th St. to River
Water Level @ 6000 C.F.S.
Surface of Ground
Bridges at Streets
Paved Channel, Ave. C to 15th St.
Concrete Channel, Mynster St. to Ave. C

FIG. 3. SECTIONS OF LINED AND UNLINED CHANNELS

land. In view of the damage and expense due to the recurring floods it is considered that the cost is well justified by the adequate flood relief which it will insure.

In all these projects the velocities will be sufficient to prevent material deposit of sediment in the lined channels through the more valuable land. For the unlined portions of the channels it is considered more economical to remove the sediment periodically than to incur the higher charge of interest on the cost of lining. In the hilly country above Bryant St. the creek causes trouble by washing the banks and will overflow at some future time when the city has been developed to its present northern limits. It is proposed, therefore, to improve and line the channel with concrete from Bryant St. up to the city limits, at a cost of $277,000. This would be an addition to any of the three projects for improvement below Bryant St.

Relief from the floods in Indian Creek has been under consideration for more than forty years and numerous plans have been proposed, including tunnels westward to the Missouri River and eastward to Mosquito Creek.

The method of controlling floods by a detention reservoir with dam is not applicable in this case, owing to the large extent of the drainage area which lies within the city limits and below the site for a dam

Floods in Indian Creek are caused generally by short sharp storms rather than by long and steady rains, the creek overflowing in from 30 minutes to 4 hours after the beginning of rain. For this reason, statistics of 24-hour rainfall are not of much value in studying the flood conditions, but of greater value are the records from tipping gages at places subject to similar rainfall conditions. From a study of such records it is estimated that for storms of 1¼ hours, which is about the period of concentration on this drainage area, the maximum rainfall would be 2.3 in. per hour About once in five years there might be a fall of 1.15 in. per hour and a fall of 1.75 in. per hour for 1¼ hours might occur once in fifty years.

Ten Years' Building and Housing Activity in New York

TEN YEARS' statistics of building activity in the several boroughs of New York City have just been prepared at the request of the authorities concerned with governmental study of the housing problem. They show that 1920 is equal in building activity to the most active year in the preceding decade, and because of the high price level exceeds all others in the total cost of construction involved. But this total includes an abnormally low amount of dwelling construction. In particular the amount of apartment house construction is exceedingly low. This phenomenon is known to be in evidence throughout the country, but it has not yet been set forth in such explicit form as in the New York tables reproduced herewith. These tables cover separately the Boroughs of Manhattan (old city of New York), Brooklyn (old City of Brooklyn, containing large areas as yet only partly built up), Bronx (the rapidly growing residential district in the northeastern part of the city), and Richmond (Staten Island, largely open country with separate villages). The different characteristics of the areas affect the tabulated data in obvious manner. Differences in the form of the statistics compiled make comparisons of the several tables inexact.

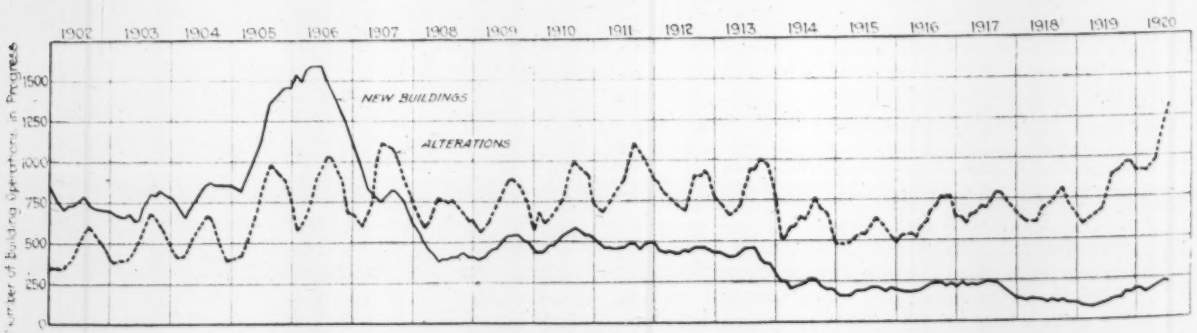
In all cases, it should be noted, the 1920 figures are given for six months only, and the probable figures for the year are a little less than double those for the first half (in Manhattan building operations for the first six months tend to run about 57 per cent of those for the year, according to R. P. Miller, superintendent of buildings).

In the general building field the most significant figures are those of Manhattan. It will be seen from the fourth column of the table that the value represented in building operations showed a declining tendency after 1912, very sharply accentuated after 1916. In 1919, however, operations reached a figure very close to the average of the preceding nine years. With prices increased somewhat since 1919, the figures for the current year promise to show at least 70 per cent increase over the preceding year. The following columns of the table (which form part of the totals given in the first group of columns) indicate prominently not only the relative insignificance of housing construction in this borough but also the present depression of apartment house construction. This is commonly interpreted as being a result of the recent agitation over rent problems within the past year.

In Brooklyn, while the value of 1920 building will not exceed that of 1919, it is far ahead of the figures for prior years, both in total value and in number of buildings. The figures are on a slightly different basis from those in Manhattan, as they refer to permits issued, instead of applications filed. House building is a far more important part of building in Brooklyn than in Manhattan, but it will be seen that the expenditure on housing for 1920 will be very far below that for 1919, and not far above the average for the previous ten years. Activity has concentrated in one-family and two-family dwellings, and fallen off in apartments.

The Borough of the Bronx shows the same phenomena in even more pronounced fashion. The expenditure on apartment house construction for 1920 will be less than one-fifth that of other years in the decade, while one-family and two-family house construction will be about normal, as will also the total expenditure on building work. In Richmond, where new housing is confined to the construction of one-family dwellings at present, activity has somewhat increased. But in considering the Richmond figures it is necessary to take note of the very low cost per dwelling ($2,800), and the slight increase of this figure from the 1915 figure of about $2,000; it appears that dwelling house activity has been kept up largely by turning to cheaper and smaller construction, since building costs are not far from three times those prevailing in 1915.

Besides giving a picture of building activity and of the present status of housing provision in New York City, the tables contain much miscellaneous information concealed in their figures. Thus, in Manhattan the average cost of tenements (includes all multi-family dwellings except hotels) in 1919 was in the neighborhood of $7,500 per apartment, while in the Bronx the average



BUILDING AND ALT RATION WORK—BOROUGH OF MANHATTAN

TEN-YEAR BUILDING ACTIVITY— IN FOUR BOROUGHS OF NEW YORK CITY

MANHATTAN
(Applications Filed)

Year	Total New Buildings: No. of Applications	No. of Buildings	Estimated Cost	Dwellings: No. of	Estimated Cost	Tenements: No. of Buildings	(Apts.)	Estimated Cost	Other Residence Buildings: No.	Estimated Cost
1910	778	838	$96,703,029	43	$1,906,300	208	(7,600)	$36,923,000	7	$955,000
1911	771	840	98,537,275	39	2,263,500	194	(7,033)	29,178,000	10	5,900,000
1912	691	757	116,325,135	28	1,532,000	182	(6,379)	30,452,000	12	7,125,000
1913	508	577	73,970,685	32	2,761,000	158	(6,337)	22,267,200	10	1,385,000
1914	375	411	45,471,165	21	1,682,000	133	(5,141)	18,916,000	9	975,000
1915	418	489	64,652,869	25	792,500	193	(6,436)	24,960,500	9	2,030,000
1916	510	564	114,690,145	38	3,065,700	183	(7,721)	37,841,500	27	26,717,000
1917	279	321	29,068,525	5	420,000	23	(838)	2,661,000	6	2,250,000
1918	178	182	8,507,000	4	215,000	9	(395)	1,780,000	1	750,0000
1919	368	379	72,283,061	19	1,904,500	44	(1,801)	13,576,000	14	8,788,000
1920 (6 mos.)	234	434	67,382,458	10	555,000	15	(....)	2,925,000	2	1,640,000

BROOKLYN
(Permits Approved)

Year	Total New Buildings: No. of Permits	No. of Buildings	Estimated Cost	Single-Family Bldgs: No.	Estimated Cost	Two-Family Dwellings: No.	Estimated Cost	Tenements: No.	Estimated Cost
1910	2,871	5,770	$34,813,720	(Incl. in next column)		4,046	$17,206,930	563	$7,523,400
1911	2,634	5,288	32,598,240	(Incl. in next column)		3,720	14,624,495	549	8,209,325
1912	2,595	5,105	36,472,377	2,021	$7,249,790	1,215	5,387,225	763	14,366,400
1913	2,250	3,616	30,719,101	1,227	4,344,925	857	3,833,820	533	12,349,500
1914	2,375	4,379	38,269,185	1,683	5,285,750	1,119	4,754,850	715	18,365,600
1915	2,750	5,121	40,300,600	1,580	5,436,065	1,575	7,555,620	920	18,880,600
1916	2,578	4,946	35,397,480	1,802	6,217,745	1,619	8,041,800	605	13,353,500
1917	1,658	2,696	27,613,290	1,060	3,558,000	536	2,804,250	201	5,348,500
1918	1,789	2,815	17,858,425	732	3,029,232	430	2,429,300	25	813,500
1919	6,348	12,889	68,137,966	4,301	22,433,825	2,221	18,262,050	295	7,811,000
1920	2,571	4,506	34,478,465	1,600	9,113,125	621	7,114,100	26	2,291,000

NOTE—Total cost of Plans and Specifications filed during the years 1918 and 1919 and the first six months of 1920:

1918 ..... $23,775,950 1919 ..... $99,813,643 First six months 1920 ..... $50,624,786

RICHMOND
(Permits Approved)

Year	Total New Buildings: No. of Permits	No. of Bldgs.	Estimated Cost	Single-Family Dwellings: No.	Estimated Cost	Two-Family Dwellings: No.	Estimated Cost	Tenements: No. of Bldgs.	(Apts.)	Estimated Cost	Other Residence Buildings: No.	Estimated Cost
1910	724	841	$3,363,868	441	$1,059,558	178	$509,512	2	(8)	$15,000	2	$15,500
1911	778	911	2,513,324	501	1,129,106	151	488,754	1	(4)	6,000	.....	.....
1912	812	1,007	3,412,103	627	1,862,128	95	297,641	.....	(....)	.....	1	1,000
1913	893	1,013	3,327,109	620	1,549,198	77	251,262	.....	(....)	.....	3	15,500
1914	1,009	1,160	2,272,898	695	1,275,320	68	240,029	.....	(....)	.....	3	60,450
1915	1,212	1,381	2,630,192	695	1,409,910	112	329,276	3	(15)	28,000 not built	5	33,724
1916	1,205	1,378	4,563,716	701	1,486,431	109	407,717	1	(4)	12,000 not built	4	40,750
1917	937	1,171	3,717,263	590	1,120,310	48	201,618	2	(110)	340,000 not built	1	9,000
1918	669	891	2,085,293	460	1,039,674	33	192,167	1	(37)	95,000 not built	1	40,000
1919	1,757	2,135	4,295,399	1,313	3,232,175	23	106,216	.....	(....)	.....	.....	.....
1920 (6 mos.)	979	1,176	2,580,117	746	2,079,410	.....	.....	.....	.....	.....	.....	.....

BRONX
(Permits Approved)

Year	Total New Buildings: No. of Permits	No. of Bldgs.	Estimated Cost	Single-Family Dwellings: No.	Estimated Cost	No. of 2-Family Dwellings	Estimated Cost of 2-Family Dwellings	No. of Tenements	No. of Apartments	Estimated Cost of Tenements	Other Residence Buildings	Estimated Cost of Other Residence Buildings
1910	1,313	2,026	$44,034,405	347	$2,337,300	273	$1,274,600	971	20,391	$34,941,000	6	$87,000
1911	940	1,357	22,837,060	296	1,831,950	264	1,160,200	372	8,184	14,500,000	4	530,000
1912	929	1,310	34,644,400	157	975,750	187	779,200	607	12,222	25,192,500	1	10,000
1913	662	846	20,072,489	99	502,722	129	655,062	330	7,371	14,943,851	1	7,000
1914	580	735	16,347,382	116	516,200	93	413,850	269	6,212	12,206,000	3	33,000
1915	701	962	28,119,100	150	642,000	67	286,700	489	11,939	22,822,000	2	17,000
1916	542	650	16,725,582	67	306,500	68	312,000	224	5,200	12,012,000	.....	.....
1917	359	640	8,545,475	90	488,500	64	347,000	59	1,685	3,770,000	.....	.....
1918	171	206	3,991,900	30	156,000	12	62,400	22	752	1,675,000	.....	.....
1919	632	1,084	21,006,865	350	2,367,000	128	865,000	95	3,311	9,654,000	.....	.....
1920 (6 mos.)	403	630	11,752,180	216	1,749,600	116	939,000	16	632	2,485,000	.....	.....

apartment cost less than $3,000 in the same year. Single-family dwellings in the Bronx increased in cost from about $4,300 apiece in 1915 to $8,100 in 1920; in Brooklyn from $3,450 to about $5,700; and in Richmond, lowest of all, from $2,030 to $2,800. Efforts to economize in construction costs may be seen in the fact that Brooklyn building costs increased from 1915 to 1920 in the ratio 1.66 for single-family dwellings, in the ratio 2.38 for two-family dwellings, and in the ratio 4.30 for apartment houses.

Additional to the building activity shown by the tables, there is a large amount of building alteration work constantly in progress. What an important factor in the building situation of New York this alteration work constitutes, and how it varies with relation to the variation in new building, is well shown by the accompanying diagram for Manhattan, covering the period of 18½ years from the beginning of 1902. The diagram shows that since the phenomenal peak in new building construction in 1906, following shortly after the completion of the first subway, building steadily decreased, reaching its lowest point in the early months of 1919, since which time a marked and well maintained improvement has gone on. During the same period of improvement, alteration work has increased by more than 50 per cent, and is now at a height largely exceeding that ever before reached in the history of the borough.

The figures on this chart are not comparable with those in the tables, as they represent number of operations instead of costs and actual building in progress at the specified time.

Hydraulic Fill at the Miami Conservancy Dams—III

Discharge Pipe Life Increased by Using High Carbon Steel—Friction Heads of 10 to 12 Ft. Developed in Pumping Heavy Glacial Drift

By C. S. Hill
Associate Editor, *Engineering News-Record*

EXCEPT at Germantown, all hydraulic fill embankments are of large area and comparatively little height. This has complicated embankment construction (1) by requiring construction in sections and (2) by necessitating many rearrangements of pipe line.

Friction Heads.—When the pumping plants for the five flood protection dams were planned there were few available data on friction head. For glacial drift it appeared that 4 ft. in 100 ft. would be a fair allowance for a velocity of 12 ft. a second in the 15-in. discharge pipe. At none of the operations has the head been less, generally, than this figure and never has it been as little except when pumping clay and fine glacial till, as in 1919, for the Taylorsville dam. At Lockington, another sluicing operation, the average friction head has been 6 ft. in 100 ft. Fair ranges at Huffman are 8 to 10 ft., and at Germantown 6 to 8 ft. The highest heads have been averaged at Englewood. Here a heavy gravel and sand, and high velocities, have given 10 to 100-ft. heads.

These high friction heads place a heavy penalty on the length of pump discharge and in a large measure explain the reason for the decision to haul the material from borrow to pit to sump and, at Englewood, to build a succession of sumps to allow the pumps to be shifted to higher and higher locations on the slope of the dam. Comparison of the figures indicates generally smaller heads at Taylorsville and Lockington than at the three other dams. Differences in the character of the material pumped probably account for these differences in head. It is interesting, however, to speculate whether in excavating by monitors and in sluicing there is not a presorting and pre-mingling of the solids which does not prevail when the material is mechanically excavated and delivered to hog-boxes whence it is washed directly into the sump, and whether this previous working over by flow does not put the mixture of solids and water into a condition in which it is more easily pumped.

Discharge Pipe Service.—About four complete replacements of discharge pipe line for each operation were estimated necessary, when the work was first planned. This estimate was based on the use of ordinary riveted steel dredge pipe. Fortunately this replacement expense, except for some of the pipe installed for the first operations, has been made unnecessary by

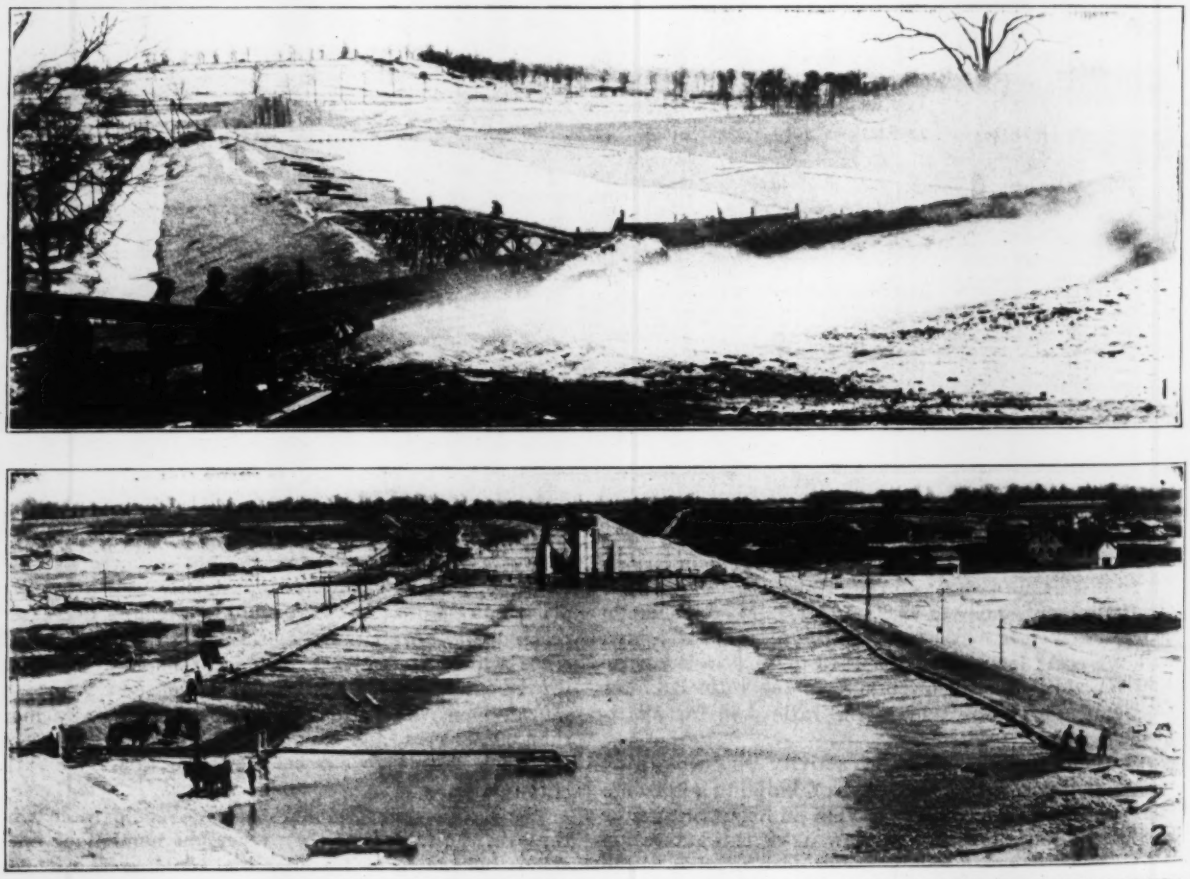


FIG. 8. TYPICAL CORE POOL AND PIPE LINE ARRANGEMENTS
(1) Sluicing Directly to Embankment at Huffman. (2) Core Pool Siphoned Off for Clay Blanket at Lockington.

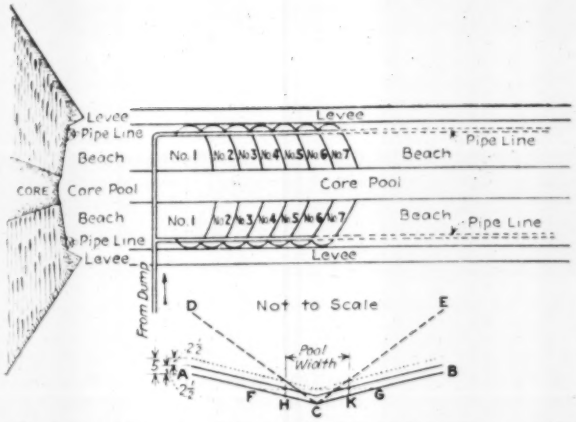


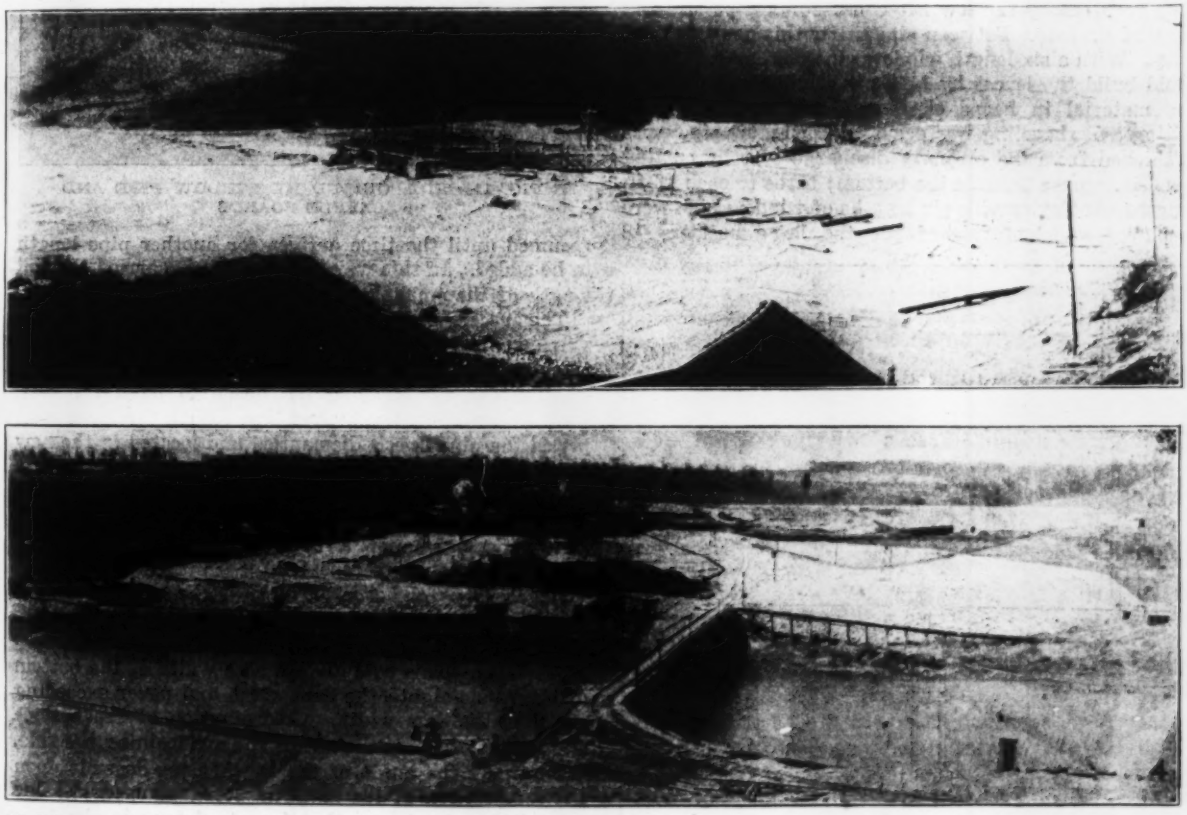
FIG. 7 DIAGRAM OF EMBANKMENT BUILDING PROCESS

the production of an alloy steel pipe of extraordinary wearing qualities. Less than 100,000 cu.yd. of material pumped ended the life of the ordinary 0.1 to 0.2 carbon steel dredge pipe and the new pipe has shown itself good for 400,000 cu.yd. It is a longitudinally welded pipe, of No. 8 gage steel plate, 15 in. inside diameter, and weighs about 29 lb. a lineal foot. The steel contains from 0.50 to 0.60 carbon and about 0.75 manganese, which are about the limits for a metal which can be bent and welded without difficulty.

As made up the pipe is in 16-ft. lengths, (two 8-ft. lengths welded together) with stovepipe joints, which are held together by loops of wire drawn taut around projecting ears on the shell near the end of each length. To insure an even wear around the circumference, the pipes are turned 120 deg. for each run. By numbering one end of each length 1, 2 and 3, at 120 deg. apart, the turning is done without error, and the lower third of the pipe, which sustains the maximum wear, is different for every lift of the fill.

Hydraulic Fill Procedure.—At the Miami dams the procedure of building the hydraulic fill is in general that universally employed. On the outer edges of the fill levees are thrown up, as shown by the diagram Fig. 7, defining the slope of the embankment. The pipe lines from the pump are parallel to and just inside the levees. Beginning at the end nearest the pump, filling is started with a short pipe line until a strip, as No. 1, is filled to pipe level down the beach from levee to core pool. Then a 16-ft. section of pipe so added to the line and strip No. 2 is filled. These processes are repeated until the end of the embankment is reached when the pipe is unjointed section by section and another lift is started and completed by repeating the whole operation. When one pump is employed the two beaches are brought up alternately; with two pumps both beaches are raised at the same time. The views Fig. 8 of the fills at four of the dams, with the diagram, make the general procedure quite clear.

Levee and Beach Construction.—Two methods of levee construction have been principally employed. That most used is construction by dragline excavators. A small caterpillar-traction machine, as shown by Fig. 9, with a 40 or 50-ft. boom and a 1½-cu. yd. bucket, travels along the beach inside the levee line, and, borrowing



AT FOUR OF THE MIAMI CONSERVANCY DISTRICT DAMS

(3) Full Length Embankment Fill at Germantown. (4) Cross-Dam and Stone Toe-Buttress at Taylorsville.

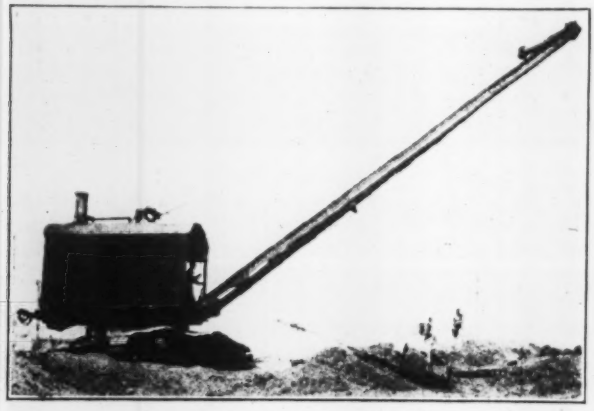


FIG. 9. CATERPILLAR DRAG LINE BUILDS CORE POOL LEVEE

material from the beach, builds up an embankment to generally twice the height of the lift being employed for making the hydraulic fill. By making the levee twice the height of the lift, dragline travel is reduced and time saved. With the dragline very little trimming by hand of the permanent outside slope is necessary and generally manual labor is reduced as compared with the second method of levee construction.

This second method used largely at Taylorsville and incidentally at some of the other dams is hydraulic fill using window pipe. At Taylorsville a combination of conditions favored the window pipe method. The beach runs flat and was built up in 2½-ft. lifts. Only one run of discharge pipe was used and the frequent changes of pipe required by the low lift called for a pipe shifting gang of six men. Between pipe shifts this gang was not busy. With a six-length window pipe discharge the men could build the levees by hand, the windows delivering the material in heaps close to the levee into which raking and shoveling was easy. The window pipe were fashioned from the ordinary discharge pipe by cutting 4 x 6-in. square holes in the bottom; three to each 16-ft. length. At Taylorsville six lengths of window pipe were employed which furnished for the levee builders 18

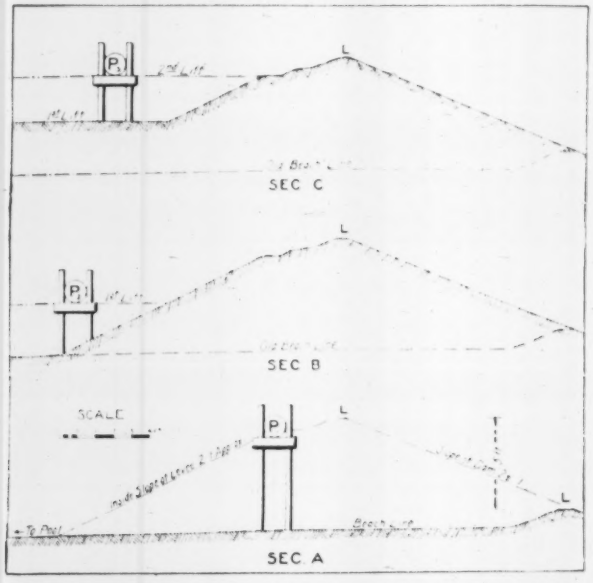


FIG. 10. LEVEE CONSTRUCTION WITH WINDOW PIPE

piles of material about 5 ft. apart and about 4 ft. inside the line of the levee crest. Only the finer materials drop through the windows so the process described was further aided by the unusual proportion of fine material in the Taylorsville borrow pit.

Beach construction ordinarily is in 4-ft. lifts, the Taylorsville operation being an exception as will be explained later. Considering a 4-ft. lift the procedure is about as follows: Starting at the end of the fill, two lengths of pipe are laid on timber bents 4 ft. above the previous beach grade. As pumping proceeds the coarse material builds up in a cone at the discharge end. The finer particles are carried down the beach toward the core pool and are distributed by size along the route until only those which are very fine enter the still water of the pool and settle to form the core. When the coarse stone has built up to the height of the pipe another length is added by laying it on the built-up fill with a timber bent supporting the outer end. Pumping is then

FIG. 11. FILL GUIDED BY WINDOW PIPE AND BAFFLE BOARDS

resumed until the time arrives for another pipe length to be added. In this way the 4-ft. lift is carried the full length of the embankment.

The successive stages of building levee and beach with window pipe at Taylorsville are best understood from the diagrams of Fig. 10. Section A shows the pipe location for a run along the beach to build the 5-ft. levee indicated by the broken line. With the levee completed the pipe line is dismantled and located in the new position shown by Section B to make a run for the first beach lift of 2½ ft. This first lift is followed by a second 2½-ft. lift as shown by Section C to complete the beach to levee level. A new levee is then built and the beach filling operations are repeated.

Beach Slope and Core Width.— The rule in placing hydraulic fill is to keep the core width, at any elevation, about equal to the height from this elevation to the top of the dam. This rule gives a core width at the bottom of about one-eighth the dam width and never exceeding one-fifth the dam width. Co-ordination of beach slope and height of lift is the means for maintaining the rule.

Normally the angle of the beach slope depends upon the composition of the material being pumped. If fine material predominates the slope is flat as in the 1919 fill at Taylorsville and if coarse material predominates,

as generally is the case at the other dams, the slope is steeper. To keep the core pool width constant the lift for each run of fill must be less if the beach is flat than it need be if the beach is steep, as indicated graphically by the diagram in Fig. 7. To raise the fill 5 ft. in one lift, having the flat bench slopes *ACB*, would spread out the pool surface to *FG*, but by using two lifts of 2½ ft. the pool width is kept reasonably close to *HK*, the normal width. If the beach slopes are steeper as *DCE*, one lift of 5 ft. can be made and the pool width maintained normal. It is this reasoning which determines the use of the 2½-ft. lift at Taylorsville and the 4-ft. lift, generally, at the other dams.

As the top of the dam is approached and the width of

FIG. 12. WELL DEFINED EDGE OF CORE POOL.

the fill decreases, the problem of core pool control requires more attention. To keep the core width down, the narrowing beaches have to be built up faster, that is with steeper slopes than when they were comparatively wide. If the borrow pit conditions make it practicable to select coarse or fine materials, alternate pumping of the two meets the requirements. Another method is to hold a greater than normal proportion of the sand and smaller pebbles high up the beach by using a window pipe discharge. Baffle board control of the beach streams is also employed to shift the deposition areas as shown by Fig. 11.

Analyses indicate the core solids to consist of about 75 to 85 per cent clay and silt and 15 to 25 per cent of very fine sand. Normally the plane separating the core fill from the beach fill is remarkably well defined as is indicated by the view Fig. 12 showing a portion of the beach margin disclosed by lowering the pool at Englewood. Ordinarily the overflow from the core pool is wasted outside the dam area. Possibly 2 per cent or more of the particles of core material fineness are carried away by the overflow. Conservation of these solids at Lockington has been accomplished by siphoning the pool overflow down the upstream slope of the dam into a dyked area where a clay blanket was required on a portion of the old stream bed. At another location to reduce the work of pumping slucing water to the sump, the pool overflow is taken to the sump. Generally there is an element of danger in this procedure which requires to be watched; a gradual accumulation of floating solids in the circulating water complicates the task of beach and core control.

All work is being performed by the construction department of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Chas. H. Paul, assistant chief engineer, and C. H. Locher, construction manager. Much credit for the success of the hydraulicking operations is due to the division engineers at the dams. All of them have given careful thought and study to the problems encountered and have made valuable suggestions for improvements in design. They are: Arthur L. Pauls, Germantown; H. S. R. McCurdy, Englewood; Barton M. Jones, Lockington; O. N. Floyd, Taylorsville and C. C. Chambers, Huffman. G. L. Albert, hydraulic engineer, has given special attention to the hydraulic fill installations and operations at all of the dams and S. M. Woodward, consulting engineer, has offered valuable advice and suggestions.

Government May Study Tunnel Problems

THAT there is a country-wide demand for a study by the government of tunnel construction is the belief of George S. Rice, chief mining engineer of the Bureau of Mines, who recently returned to Washington from a trip through the West. Several of the cities which he visited have vehicular tunnel projects under consideration. He also looked into the proposal to drive the six-mile Moffat tunnel in Colorado. Before the Moffat railroad is extended to Salt Lake City, it is proposed to drive a double tunnel to prevent the almost prohibitive grades which otherwise would be necessary. The Bureau of Mines has been conducting research on mine gases for many years. A year ago, the bureau was solicited by several eastern cities, interested in vehicular tunnel construction, to co-operate in a study of the effect of the exhaust gases from automobiles in long tunnels. Congress declined to allow any appropriation for this work, but it is believed that the appropriation failed from the desire to eliminate all new items from the appropriation bills. It is believed that the next Congress will be more generous, especially in view of the widespread demand for authoritative data, not only in the matter of gases in tunnels but in the whole matter of ventilation during construction and subsequently. Due to fire hazard this phase of tunnel construction should be the subject of government study, in the opinion of many since the government is in a better position to gather the necessary data than is any other agency.

American Personnel for Merchant Marine

Six out of ten men now entering the merchant marine service under the U. S. Shipping Board are American citizens, recent advice from the office of the board states. In 1917 only one in ten of enlistments below the grade of officer on American ships had American citizenship. The board claims that "it is important that as fast as possible all foreigners should be replaced by Americans."

Concrete Trusses and Cantilever Girders in Theatre

Roof Cost Reduced by Substituting Concrete for Steel—Balcony Has Heavy Girders and Long Cantilevers

ROOF trusses, long balcony girders and long cantilevers, all of reinforced concrete, are important structural features in the new Euclid Theatre at Cleveland, Ohio. This building has capacity for 2,000 seats, including the main floor and the balcony. The roof is supported by four concrete trusses 82 ft. 3 in. long over all and 10 ft. deep between centers of chords.

The use of these concrete trusses was due to conditions of the steel market. Steel trusses were included in the original design, but when the engineers were ready to place the contract they found it impossible to secure delivery within the time required. In order to avoid the necessity of canceling the entire project it was decided to design trusses of concrete. On completion of the work, it was found that this construction had effected a saving of $4,000.

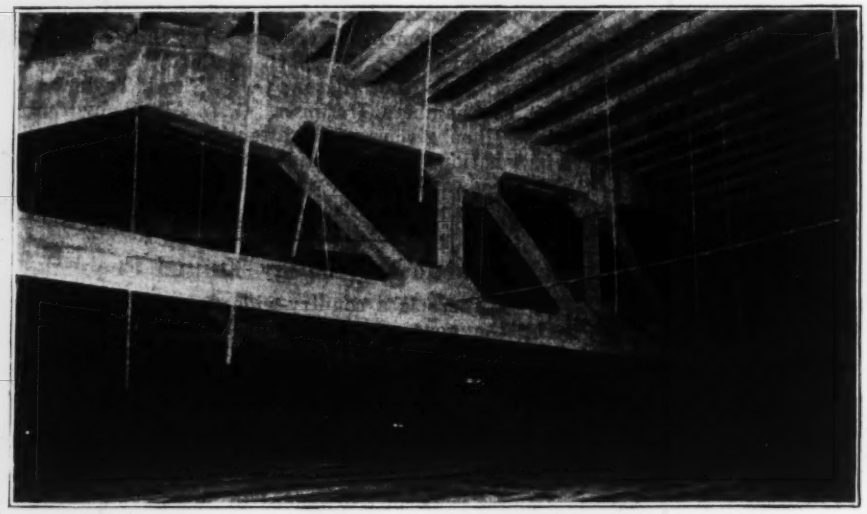


FIG. 1. CONCRETE TRUSS OF 82 FT. SPAN FOR THEATER

A view of one of these trusses, with the concrete purlins and roof slab is shown in Fig. 1. Details of the truss design, with dimensions, reinforcement and stresses, are given in Fig. 2. A concrete mix of 1:2:4 was used, the coarse aggregate being blue limestone not exceeding ¾-in. in size. Tension in the reinforcing steel is taken at 16,000 lb. per square inch and compression in the concrete is taken at 650 lb. The trusses are designed for an assumed dead load of 90 lb. per square foot from the trusses, purlins, roof slab and suspended ceiling. The design includes also a live load of 35 lb. per square foot for snow.

At each end the truss is T-shaped in plan, in order to give ample area on a brick pier, these piers being built into the walls. Dowels anchor one end of the truss to the pier. The trusses are spaced 20 ft. c. to c., and carry pre-cast concrete purlins of 12-in. I-beam section which are anchored at the ends by dowels embedded in the concrete of the top chords. Upon the purlins is a monolithic concrete roof slab 2 in. thick, covered with a weather coating of bituminous material and gravel. Hanger rods in the bottom chords carry a suspended ceiling of expanded metal and plaster about 3 in. below the trusses.

As each truss weighs about 32 tons, the forms had to be carried by a heavy falsework structure about 50 ft. high, resting on footings at the floor level and thoroughly braced. Wood forms were used and were left in place for about sixty days before removal. Concrete was mixed fairly wet and was placed by means of a tower with elevator bucket and chute. For each truss, the pouring was continued without interruption until its completion.

An unusual element of the interior arrangement, which had an influence on the structural design, was the placing of the stage and balcony across diagonally

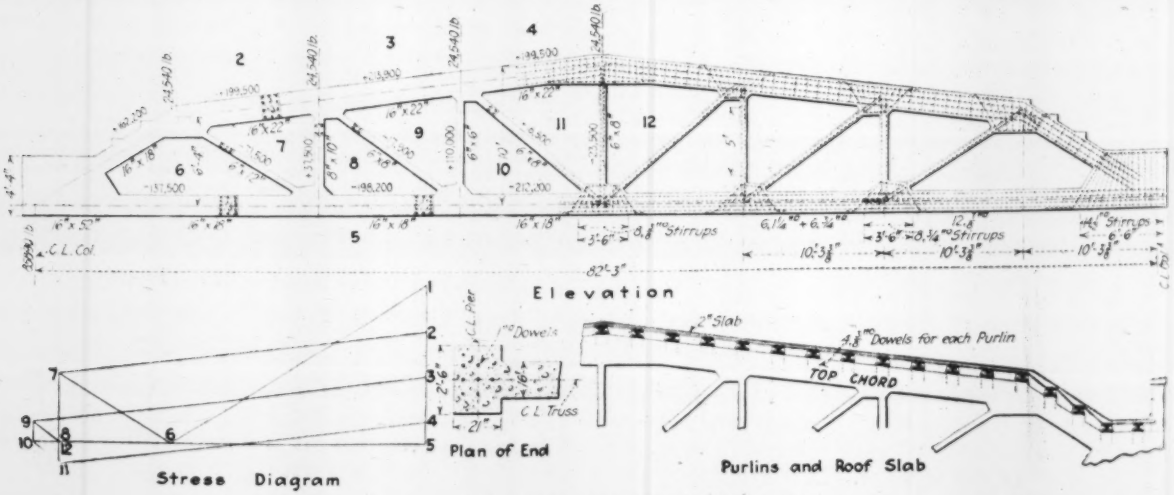


FIG. 2. DESIGN OF CONCRETE ROOF TRUSS

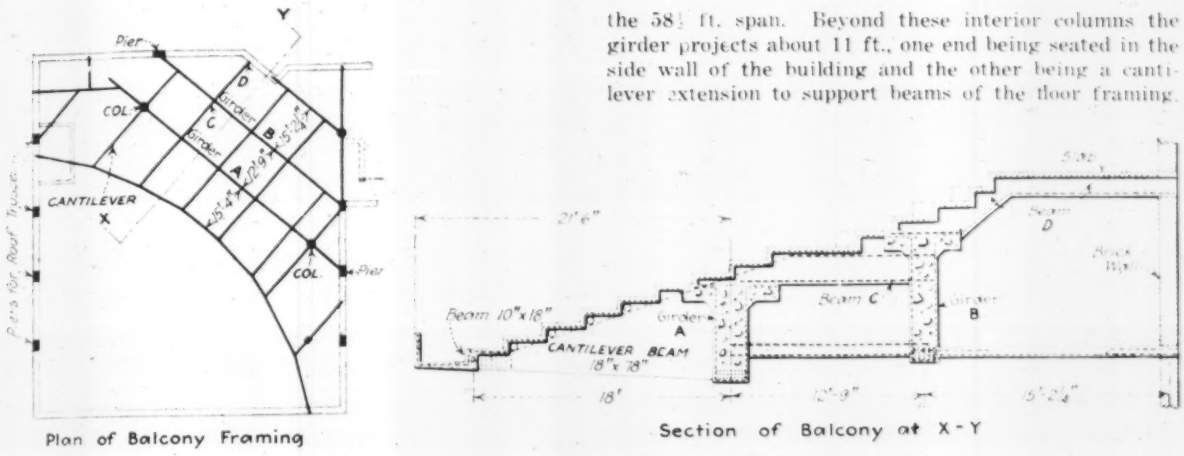


FIG. 3. BALCONY FRAMING WITH CANTILEVERS AND LONG GIRDERS

opposite corners instead of along opposite sides of the rectangular building. In this way the balcony was given a much longer front and its seating capacity is said to have been increased nearly 30 per cent. Concrete framing for the balcony was included in the original design. Its main members are two girders of T-section having main spans of 63½ and 58½ ft. As shown by the framing plan, Fig. 3, these girders extend across the corner of the theatre space, the longer one resting on columns in the side walls and the shorter one being carried by interior columns but extending beyond these to support auxiliary parts of the framing. It will be seen by the drawing that the T-heads are not embedded in the floor slab.

Cantilever girders having their upper sides inclined to conform to the slope of the balcony floor extend beyond the second main girder. These girders and cantilevers, with the 3 in. stepped floor slab which they carry, are designed for a live-load of 80 lb. per square foot. The longer girder is 9 ft. deep and 5 ft. wide over the T-head or flange, with a thickness of 22 and 16 in. for the web and flange respectively. In the shorter girder the depth is limited by the height between the ceiling and balcony floor, so that to obtain the required strength it was necessary to make the web 28 in. thick, with a 16-in. head 6 ft. 6 in. wide. The reinforcement of longitudinal bars, inclined shear bars and stirrups is arranged as shown in Fig. 4.

Circular columns with spiral reinforcement support angular section and are diagonal to the line of the girder, as shown. The columns are seated on footings of plain concrete in good clay soil.

This theatre building was erected in 1919 and its total cost was about $350,000. Both the general and structural design were prepared by the W. S. Ferguson Co., engineers and architects, Cleveland, Ohio, and this firm also superintended the construction. The Ed. Paulson Co., of Cleveland, was the general contractor for the buildings.

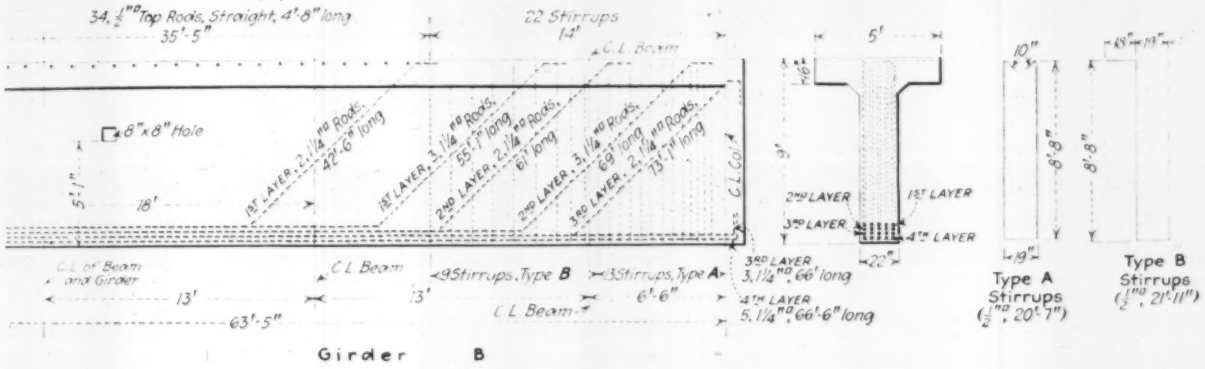


FIG. 4. CONCRETE T-GIRDER OF 63½-FT. SPAN

Wall columns supporting the 63½ ft. girder are of rect-

Unusual Damage to Bridge by Destroyer

A drifting torpedo-boat destroyer recently damaged the Forth River bridge at Alloa, Scotland, so seriously that "it is estimated that the bridge will have to be closed to traffic for at least six months," according to *The Engineer* of Aug. 20, 1920. The bridge, crossed by the Caledonian Ry., is a wrought-iron structure of twenty-one spans, totaling 615 ft. long, and was built in 1885. A surrendered German destroyer broke away from its moorings at South Alloa on Aug. 15, and after colliding with the bridge was found wedged between two of the piers. As a result of the collision, two of the stone piers are damaged "and a considerable length of girders destroyed." It is to be presumed that the bridge was not of very substantial construction, as indicated by the nature of the damage.

Chicago-Indianapolis Improvement Big Four Railroad

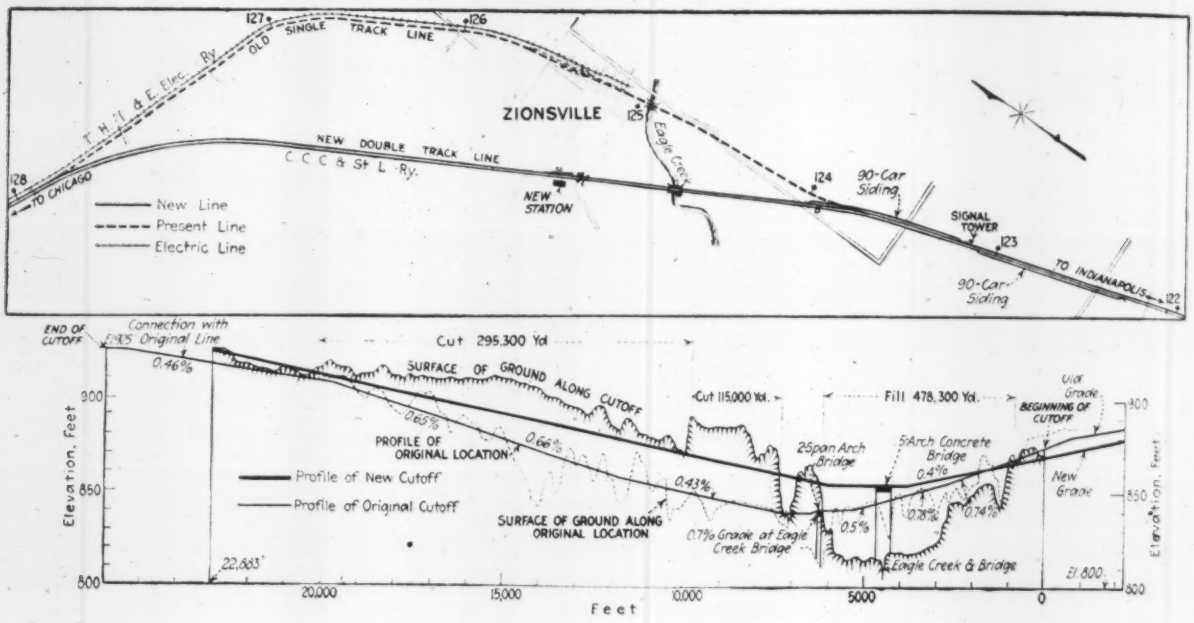
Grade Reduction and Double-Tracking Program to Reduce Time for Heavier Trains—Short Cut-Off Costs $1,000,000

RELOCATION and grade reduction at considerable expense on a line of comparatively easy grade is included in the double-tracking of the Chicago-Indianapolis line of the Cleveland, Cincinnati, Chicago & St. Louis Ry. This improvement is being undertaken in order to increase train loads and reduce running time, thus providing for increasing traffic and also eliminating overtime pay for train crews. That the wage question has become an important factor in railway improvement work was shown in *Engineering News-Record*, of March 25, 1920, pp. 602 and 615.

From Indianapolis to Kankakee, where the line connects with the Illinois Central R.R. for access to Chicago, there are numerous grades of 0.6 to 0.78 per cent, but the improvement program provides for a maximum grade of 0.4 per cent, except for pusher grades at Lafayette, Ind. The maximum curves will be of 2 deg. In grade reduction the original location is retained as a rule, and in most cases only light earthwork is involved. As there are few watercourses crossed the work consists mainly in lowering summits rather than raising sags.

A stretch of relocation with heavy grading has been introduced at Zionsville in order to improve both profile and alignment as shown in the accompanying drawing. The old line from the south is on an ascending grade of 0.4 to 0.63 per cent from Mile 122 to 123, beyond which it drops with long stretches of 0.33 to 0.78 per cent to Mile 125, traversing the town at street level and then ascending again on grades of 0.4 to 0.66 per cent to Mile 128. A long 3-deg. curve with a central angle of about 80 deg. occurs near the top of the steeper grade. This combination of grade and curve is troublesome for heavy trains. The passage through the main part of the town, with several grade crossings, is also objectionable.

The new line descends at 0.4 per cent to Eagle Creek, crosses the valley by a concrete arch bridge 300 ft. long having five arches of 45 ft. span, and ascends on a grade of 0.4 per cent to connect with the present line. This diversion passes outside of Zionsville, eliminating the street level line and spanning the main road from town by an overhead concrete bridge adjacent to the new passenger and freight station. It will be seen from the two profiles that the new line has much heavier grading, being carried through high ground which was avoided in the original location in order to keep down the construction cost. A fill of nearly 480,000 cu.yd. is required across the valley, with a maximum height of about 40 ft. Beyond this are two long cuts 10 to 20 ft. deep, aggregating 411,000 cu.yd. Two steam shovels worked the long cuts and were served by 10-car trains of 12-yd. dump cars which made the fill by dumping from a framed trestle having posts and bracing of round timbers.



RELOCATION IMPROVES GRADES AND CURVES

From Indianapolis to Kankakee, 206 miles, averages six passenger and ten freight trains each way daily, these figures being for both schedule and extra trains. Movements are controlled by the manual block system, the blocks being about fifteen miles long and having the signal towers located mainly at the meeting ends of double passing sidings about 4,000 ft. long. Some of these sidings will be linked into the new double track, but others will remain as relief or passing tracks. Freight trains have 50 to 60 cars, the standard loading being 1,800 tons for engines of the 2-8-0 class. With the completion of the improvement these engines will be able to take about 75 cars with 2,300 tons train load. Further, the double track will eliminate delays at sidings to such an extent that the overtime pay to freight train crews will be negligible.

The improvement program is being carried out under the direction of C. A. Paquette, chief engineer, and

O. E. Selby, principal assistant engineer, of the Cleveland, Cincinnati, Chicago & St. Louis Ry.; A. M. Turner is district engineer in charge of the Zionsville work. The Dunn & McCarthy Co., Chicago, had the contract for grading; the Eagle Creek bridge was built by A. J. Yawger & Co., and the highway bridges were built by the A. C. Loomis Co., both of Mattoon, Ill. The total cost of the cut-off was about $1,000,000.

Costs on Four Types of Pavement in Philadelphia Test Road

Twenty-Six Sections, Comprising Bituminous Macadam Mixed and Penetration Methods, Concrete and Vitrified Block Compared

A GROUP of eight sections of penetration macadam road, forming a part of a test road built in 1912 and 1913 by the Bureau of Highways, Philadelphia Department of Public Works, has proved the least expensive to the city as compared with the other types upon the test road—bituminous macadam, mixed method, concrete and brick. Averaging the first cost, the interest at 4 per cent for 7 yrs., and the maintenance, the average total cost at the first of this year on the penetration macadam sections is shown to be $1.7738 per sq.yd. as compared with $2.0776 for bituminous macadam mixed method, $3.006 for concrete and $3.5109 for brick. Twenty-six sections in all were laid over a total length of road of 3.41 mi. Six sections of bituminous macadam mixed method were laid, eight of penetration macadam, five of concrete base with a bituminous top, and seven of vitrified block. All sections were laid upon the same subgrade, it being an old water bound macadam road. Surface treatment was given practically all of the concrete sections, two of which are patent pavement—hassam and bicomac.

After the winter of 1919-1920, all the penetration sections except Section 24 required rebuilding. Considerable work was also done on Sections 1, 2, 6 and 9 of the mixed type. No work was necessary on any of the brick sections. Section 25—bicomac—was cold patched.

The penetration macadam sections were built to a compact thickness of 3 in. of 1½-in. trap rock, each section penetrated with either a different amount or kind of binder, and sealed with a coat of the same material as that used in the binder. The best known of the binders available at the time of the construction of the test road were used in these penetration roads, the amount of the binder varying from 1½ gal. to 1.8 gal. per sq.yd. In the construction of the bituminous macadam, mixed method sections, ½-in. to 1½-in. trap rock was used in four sections, limestone on a fifth section and bank gravel not over 1 in. in diameter on the sixth section. Various patent methods of laying bituminous macadam, mixed method, paving were used in the construction of these six sections.

Concrete sections were built in three cases 5 in. thick, of a 1:3:6 mix. The fourth section was built according to hassam specifications and the fifth constructed 4 in. thick of a 1:3:6 mix, a 1-in. wearing surface being laid following the bicomac specifications. Expansion joints were omitted in Section 3, but included in Section 5, being laid at 40 ft. intervals and being

TABLE II FIRST COST, INTEREST, MAINTENANCE AND TOTAL COSTS ON TWENTY-SIX TEST SECTIONS

Type and Section	First Cost	Interest at 4% for Seven Years	Maintenance Cost for Seven Years	Total Cost
Bit. Mac., Mixed Method				
Section 1	$0.7573	$0.2120	$1.1044	$2.0737
Section 2	1.6118	.4512	.2741	2.3371
Section 6	1.2581	.3523	.3927	2.0031
Section 7	1.4291	.3901	.2738	2.0930
Section 11	1.2836	.3594	.1078	1.7508
Section 12	1.6083	.4503	.1500	2.2086
Average				2.0277
Bit. Mac. Penetration				
Section 16	.8866	.2482	.2183	$1.6332
Section 17	1.0599	.2968	.5220	1.8787
Section 19	1.0577	.2962	.3056	1.6595
Section 20	1.0154	.2843	.7301	2.0298
Section 21	1.0780	.3018	.4977	1.8775
Section 22	1.2150	.3402	.1893	1.7445
Section 23	1.1511	.3223	.1424	1.6158
Section 24	1.2997	.3639	.0881	1.7517
Average				1.7738
Concrete Base—Bit. Top				
*Section 3	1.1462	.3209	1.8424	3.3095
*Section 5	.9834	.2754	2.1913	3.4501
†Section 9	1.2101	.3388	.2750	2.8239
*Section 14	1.2505	.3501	1.7842	3.3848
Section 15	1.8671	.5228	.1718	2.5617
Average				3.0060
Vit. Block				
Section 4	2.6531	.7429	.0518	3.4478
Section 8	2.6032	.7289	None	3.3321
Section 10	2.5532	.7149	None	3.2681
Section 13	2.8443	.7964	None	3.6407
Section 15	2.6401	.7392	.1295	3.5088
Section 18	2.8670	.8028	None	3.6698
Section 26	2.8834	.8075	None	3.6909
Average				3.5083

* Entire new sheet asphalt surface placed in 1918.
† Partly new base and top of different character in 1916.

TABLE I. MAINTENANCE DATA ON TWENTY-SIX TEST SECTIONS OF PHILADELPHIA HIGHWAY

Section	Type of Road	Surface Area in Sq.Yd.	Original Cost per Sq.Yd.	Total Maintenance Cost per Year 1913	1914	1915	1916	1917	1918	1919	Average Annual Maintenance per Sq.Yd.
1	Bit. mac., mixed method	6,578	$0.7573		$3	$104	$849	$5,040	$862	$365	$0.1569
2	Bit. mac., mixed method	1,788	1.6118					9	49	432	.0393
3	Concrete, bit. top	533	1.1462			87	31	37	683	144	.2632
4	Vit. block, conc. base	444	2.6531					21	8		.0074
5	Concrete, bit. top	1,244	0.9834			180	66	76	2,094	310	.3130
6	Bit. mac., mixed method	2,222	1.2581					168		704	.0561
7	Bit. mac., mixed method	2,222	1.4291						8	600	.0390
8	Vit. block, conc. base	533	2.6032				No Repairs				
9	† Concrete	2,933	1.2101			2 884	885	2		502	.1107
10	Vit. block, conc. base	533	2.5532				No Repairs				
11	Bit. mac., mixed method	1,067	1.2836	25		23	67				.0151
12	Bit. mac., mixed method	1,067	1.6083					6	454		.0215
13	Vit. block, conc. base	622	2.8443				No Repairs				
14	Hassam, bit. top	978	1.2505				53	25	1,667		.2549
15	Vit. block, conc. base	533	2.6401						69		.0184
16	Bit. mac., penetration	1,067	0.8866		10	22	103	12	68	18	.0712
17	Bit. mac., penetration	640	1.0599			3	78	16	237		.0747
18	Vit. block, conc. base	427	2.8670				No Repairs				
19	Bit. mac., penetration	1,067	1.0577			12	109	32	124	49	.0437
20	Bit. mac., penetration	1,067	1.0154		4	40	204	41	490		.1043
21	Bit. mac., penetration	1,067	1.0780			8	174	240	86	23	.0713
22	Bit. mac., penetration	1,067	1.2150				76	13	64	49	.0270
23	Bit. mac., penetration	1,067	1.1511				88	46	28		.0216
24	Bit. mac., penetration	1,067	1.2997				79	15			.0127
25	Concrete, bit. top	978	1.8671		128	3	14	22	10		.0274
26	Vit. block, conc. base	1,004	2.8834				No Repairs				

1 With and without bituminous top. 2. Concrete base renewal.

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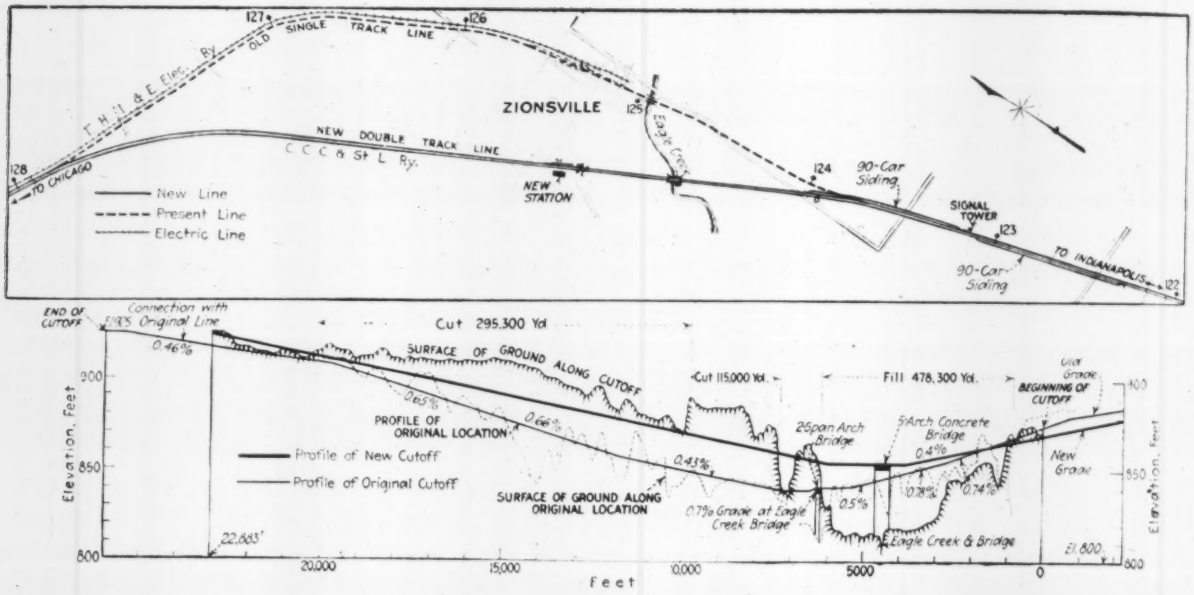

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Traffic between Chicago and Indianapolis, 206 miles, averages six passenger and ten freight trains each way daily, these figures being for both schedule and extra trains. Movements are controlled by the manual block system, the blocks being about fifteen miles long and having the signal towers located mainly at the meeting ends of double passing sidings about 4,000 ft. long. Some of these sidings will be linked into the new double track, but others will remain as relief or passing tracks. Freight trains have 50 to 60 cars, the standard loading being 1,800 tons for engines of the 2-8-0 class. With the completion of the improvement these engines will be able to take about 75 cars with 2,300 tons train load. Further, the double track will eliminate delays at sidings to such an extent that the overtime pay to freight train crews will be negligible.

The improvement program is being carried out under the direction of C. A. Paquette, chief engineer, and

O. E. Selby, principal assistant engineer, of the Cleveland, Cincinnati, Chicago & St. Louis Ry.; A. M. Turner is district engineer in charge of the Zionsville work. The Dunn & McCarthy Co., Chicago, had the contract for grading; the Eagle Creek bridge was built by A. J. Yawger & Co., and the highway bridges were built by the A. C. Loomis Co., both of Mattoon, Ill. The total cost of the cut-off was about $1,000,000.

Costs on Four Types of Pavement in Philadelphia Test Road

Twenty-Six Sections, Comprising Bituminous Macadam Mixed and Penetration Methods, Concrete and Vitrified Block Compared

A GROUP of eight sections of penetration macadam road, forming a part of a test road built in 1912 and 1913 by the Bureau of Highways, Philadelphia Department of Public Works, has proved the least expensive to the city as compared with the other types upon the test road—bituminous macadam, mixed method, concrete and brick. Averaging the first cost, the interest at 4 per cent for 7 yrs., and the maintenance, the average total cost at the first of this year on the penetration macadam sections is shown to be $1.7738 per sq.yd. as compared with $2.0776 for bituminous macadam mixed method, $3.006 for concrete and $3.5109 for brick. Twenty-six sections in all were laid over a total length of road of 3.41 mi. Six sections of bituminous macadam mixed method were laid, eight of penetration macadam, five of concrete base with a bituminous top, and seven of vitrified block. All sections were laid upon the same subgrade, it being an old water bound macadam road. Surface treatment was given practically all of the concrete sections, two of which are patent pavement—hassam and bicomac.

After the winter of 1919-1920, all the penetration sections except Section 24 required rebuilding. Considerable work was also done on Sections 1, 2, 6 and 9 of the mixed type. No work was necessary on any of the brick sections. Section 25—bicomac—was cold patched.

The penetration macadam sections were built to a compact thickness of 3 in. of 1½-in. trap rock, each section penetrated with either a different amount or kind of binder, and sealed with a coat of the same material as that used in the binder. The best known of the binders available at the time of the construction of the test road were used in these penetration roads, the amount of the binder varying from 1½ gal. to 1.8 gal. per sq.yd. In the construction of the bituminous macadam, mixed method sections, ½-in. to 1½-in. trap rock was used in four sections, limestone on a fifth section and bank gravel not over 1 in. in diameter on the sixth section. Various patent methods of laying bituminous macadam, mixed method, paving were used in the construction of these six sections.

Concrete sections were built in three cases 5 in. thick, of a 1:3:6 mix. The fourth section was built according to hassam specifications and the fifth constructed 4 in. thick of a 1:3:6 mix, a 1-in. wearing surface being laid following the bicomac specifications. Expansion joints were omitted in Section 3, but included in Section 5, being laid at 40 ft. intervals and being

TABLE II FIRST COST, INTEREST, MAINTENANCE AND TOTAL COSTS ON TWENTY-SIX TEST SECTIONS

Type and Section	First Cost	Interest at 4% for Seven Years	Maintenance Cost for Seven Years	Total Cost
Bit. Mac., Mixed Method				
Section 1	$0.7573	$0.2120	$1.1044	$2.0737
Section 2	1.6118	.4512	.2741	2.3371
Section 6	1.2581	.3523	.3927	2.0031
Section 7	1.4291	.3901	.2738	2.0930
Section 11	1.2836	.3594	.1078	1.7508
Section 12	1.6083	.4503	.1500	2.2086
Average				2.0277
Bit. Mac. Penetration				
Section 16	.8866	.2482	.2183	$1.6332
Section 17	1.0599	.2968	.5220	1.8787
Section 19	1.0577	.2962	.3056	1.6595
Section 20	1.0154	.2843	.7301	2.0298
Section 21	1.0780	.3018	.4977	1.8775
Section 22	1.2150	.3402	.1893	1.7445
Section 23	1.1511	.3223	.1424	1.6158
Section 24	1.2997	.3639	.0881	1.7517
Average				1.7738
Concrete Base—Bit. Top				
*Section 3	1.1462	.3209	1.8424	3.3095
*Section 5	.9834	.2754	2.1913	3.4501
†Section 9	1.2101	.3388	.2750	2.8239
*Section 14	1.2505	.3501	1.7842	3.3848
Section 25	1.8671	.5228	.1718	2.5617
Average				3.0060
Vit. Block				
Section 4	2.6531	.7429	.0518	3.4478
Section 8	2.6032	.7289	None	3.3321
Section 10	2.5532	.7149	None	3.2681
Section 13	2.8443	.7964	None	3.6402
Section 15	2.6401	.7392	.1295	3.5088
Section 18	2.8670	.8028	None	3.6698
Section 26	2.8834	.8075	None	3.6909
Average				3.5083

* Entire new sheet asphalt surface placed in 1918.
† Partly new base and top of different character in 1916.

TABLE I. MAINTENANCE DATA ON TWENTY-SIX TEST SECTIONS OF PHILADELPHIA HIGHWAY

Section	Type of Road	Surface Area in Sq.Yd.	Original Cost per Sq.Yd.	Total Maintenance Cost per Year 1913	1914	1915	1916	1917	1918	1919	Average Annual Maintenance Sq.Yd.
1	Bit. mac., mixed method	6,578	$0.7573		$3	$104	$849	$5,040	$862	$365	$0.1569
2	Bit. mac., mixed method	1,788	1.6118					9	49	432	.0393
3	Concrete, bit. top	533	1.1462			87	31	37	683	144	.2632
4	Vit. block, conc. base	444	2.6531					21	8		.0074
5	Concrete, bit. top	1,244	0.9834			180	66	76	2,094	310	.3130
6	Bit. mac., mixed method	2,222	1.2581					168		704	.0561
7	Bit. mac., mixed method	2,222	1.4291						8	600	.0390
8	Vit. block, conc. base	533	2.6032				No Repairs				
9	†Concrete	2,933	1.2101			2 884	885	2		502	.1107
10	Vit. block, conc. base	533	2.5532				No Repairs				
11	Bit. mac., mixed method	1,067	1.2836	25		23	67				.0151
12	Bit. mac., mixed method	1,067	1.6083					6	154		.0215
13	Vit. block, conc. base	622	2.8443				No Repairs				
14	Hassam, bit. top	978	1.2505				53	25	1,667		.2549
15	Vit. block, conc. base	533	2.6401						69		.0184
16	Bit. mac., penetration	1,067	0.8866		10	22	103	12	68	18	.0712
17	Bit. mac., penetration	640	1.0599			3	78	16	237		.0747
18	Vit. block, conc. base	427	2.8670				No Repairs				
19	Bit. mac., penetration	1,067	1.0577			12	109	32	124	49	.0437
20	Bit. mac., penetration	1,067	1.0154		4	40	204	41	490		.1043
21	Bit. mac., penetration	1,067	1.0780			8	174	240	86	23	.0713
22	Bit. mac., penetration	1,067	1.2150				76	13	64	49	.0270
23	Bit. mac., penetration	1,067	1.1511				88	46	28		.0216
24	Bit. mac., penetration	1,067	1.2997				79	15			.0127
25	Concrete, bit. top	978	1.8671		128	3	14	22	10		.0274
26	Vit. block, conc. base	1,004	2.8834				No Repairs				

† With and without bituminous top. 2. Concrete base renewal.

asphalt filled. All concrete sections were given bituminous treatment.

The vitrified block pavement was laid in the usual method upon a 4-in. concrete base, a sand cushion and cement grout being used in each of the seven sections. A concrete curb was also provided for brick paving.

Cost analyses made in the accompanying tables cover all costs: Preparation of foundation, the pavement itself, trimming of shoulders, bituminous treatment in the case of concrete sections and the concrete curbs in the case of the brick section.

In general the sections of road are in good condition, though extensive repair has been made to various sections during the past two or three years. At the end of 1919, when the last minute inspection was recorded, all the bituminous macadam, mixed method, sections, were found to be in good condition, though in Section 11 the edges were breaking away in Section 12, there was some sign of disintegration of the pavement itself. The penetration macadam sections were also in good condition with the exception of Section 17, which was reported wavy, possessing longitudinal side cracks and frayed edges. Sections 23 and 24 also were breaking away at the edges of the pavement.

All the concrete sections were reported as being in good condition except Section 25, the bituminous surface of which was wavy, had bad worn out spots at one end and showed distinct signs of disintegration along the edges.

On all the brick sections longitudinal cracks were noted, usually appearing at, or to one side, of the crown. The concrete header had disintegrated upon all brick sections. The bricks themselves were generally in good condition except in Section 10, where they were found to be chipped and cracked at one end of the section through settlement of the foundation, and on Section 13, where a few bricks were found to be slightly chipped.

The cost analysis takes into account rental of some equipment used such as road rollers, water wagons and tar kettles. No allowance, however, was made for the use of the asphalt plant on the bituminous macadam, mixed method sections.

Unit Suburban Service Proposed for Chicago

Suburban through routes for Chicago steam railway service, crossing the city and operated as units regardless of separate ownership of different parts of the lines were advocated by J. R. Bibbins, supervising engineer of the Arnold Co., in a recent paper before the Western Society of Engineers. As an example he suggested a connection of the Chicago & Northwestern Ry. terminal on the northwest side with the Illinois Central R.R. terminal on the southeast side of the city. This would distribute the crowds now concentrated at the two points and would eliminate much of that part of the congested street car traffic which consists of suburban passengers going to and from the main stations. This is only one of several possible connections. As to unit operation, Mr. Bibbins says: "The through routes will require the interchange of equipment, yard terminals, coach yards, etc., resulting from the overlapping service. But these conditions, now opposed largely from the viewpoint of independent competitive operation, will be completely remedied when the day arrives for that far more important consideration dictated by economy and common sense, namely, complete ultimate terminal unification."

Loss of Head in a 12-Inch Gate in a 16-Inch Pipe Line

By THOMAS E. LALLY
Assistant Engineer, Water Department, Boston, Mass.

Abstract of Paper Read Before the New England Water Works Association, September, 1920.

THE loss of head caused by placing a 12-in. gate in a 16-in. pipe line under 57-lb. static head on the Boston water-works was found to range from 0.01 lb. with a flow of 500 gal. per minute to 0.92 lb. at 10,200 gal. per minute. So far as the writer knows, losses due to such large flows through a gate of this size have never before been recorded.

The 12-in. gate was placed between two 16 x 12-in. reducers. The gate and reducers were of the Boston Water-Works standard taken from stock and placed in the line. The test line was provided by cutting in a 12-in. gate on a 30-in. feeder line. From this gate a 12-in. line was extended to the street line, where it was brought to the surface by easy curves and continued on blocking so that the bottom of the pipe was about 6 in. from the ground. The line was further extended by putting in a 12 x 16-in. increaser and then 16-in. pipe for a certain distance when a 16 x 12-in. reducer and a 12-in. gate with a 12 x 16-in. increaser were set. The pipe was then 16 in. for a certain distance, where a 16 x 12-in. reducer and a 12-in. gate were introduced. Then the line was continued with 12-in. pipe to a curve and a special casting, with a flange, increasing to 14 in. internal diameter. To this casting was attached a bronze forebay to which it was possible to attach nozzles varying from 8 to 2½ in. in size.

Carbon tetrachloride with a specific gravity of 1.60 was used as an indicator in the U-tube employed to determine the loss of head caused by the gate. Mercury might have been used but, as the loss expected was small, and the specific gravity of mercury is about 13.56 it will be seen that the carbon tetrachloride is eleven times more sensitive and small differences in pressure give greater deflections in the U-tube.

Flow was controlled by the last 12-in. gate, thereby keeping the gate under test always full of water. This control gate was operated by a hand wheel and any pressure desired could be obtained in the forebay within the range of the nozzle used. From pressure readings on the forebay gage, after corrections for the height of the gage over the center of the nozzle, the discharge was calculated by the use of Freeman's formula. Readings on the gage and the difference on the U-tube were taken simultaneously and from these readings, it was possible to know the discharge and the loss for any flow up to the capacity of the nozzle. When the pressure in the forebay did not increase on the wider opening of the control gate, it was assumed that the capacity of the nozzle had been reached. The next larger nozzle was then used and by the control gate the full range of the discharge was run.

The results of the tests were plotted on cross section paper. The curve did not follow the mathematical curve for losses. This rule that "the loss in friction is as the square of the discharge," while near enough for practical purposes, did not obtain in these tests. This caused a feeling that there was something wrong in the first test and other tests were run, special care being taken to get the air all out of the lines and the connections tight in every way.

It was found that the plotting of the curve, on a large scale for the losses, caused the difference to stand out and while it was small it looked large on the plot. Then, taking Freeman's paper, "Hydraulics of Fire Streams" and analyzing some of the tabulated data, it was found that the loss did not vary as the square but ranged from 1.775 to 1.92. Freeman, in the same paper (p. 338) says that his results do show "that there is a slight divergence from the law." Flinn, Weston and Bogert "Waterworks Handbook," 1916 edition, p. 560, says: "Textbooks make the general statement that the friction head in pipes varies nearly as the square of the velocity. Researches indicate that this exponent varies between 1.75 and 2.00."

The velocities in the 12-in. gate under test varied from 1.3 ft., per second discharging 750 gal. per minute to 34 ft. per second at 12,000 g.p.m. With these references in view, the writer felt that the fact that the curve did not agree with the curve of the squares was not due to errors in the methods or the gage connections or readings.

With a flow of 500 g.p.m. the loss was 0.01 lb.; at 1,000 g.p.m. it was scarcely larger; at 2,000 g.p.m. it was about 0.03 lb.; 4,000 g.p.m. showed about 0.12 lb.; 5,000 g.p.m. about 0.20 lb. 6,000, 0.29 lb.; 8,000, about 0.51 lb. 10,200 g.p.m. gave 0.92 pounds.

These losses show clearly that we may place this smaller size gate in our pipe lines and not loose over one pound pressure, with a discharge which I think would seldom be required even in a 16-in. line.

Concrete Cantilever Construction in Chicago Garage

Single and Double Cantilever Beams Support 11-Ft. Span of Floor and Roof Slab and Carry 50-Ft. Monitor Trusses

EXCEPTIONALLY long and heavy concrete girders, with cantilever construction for portions of the second floor and roof around large light courts, are striking features in the structural design of a two-story automobile storage and service building recently completed in Chicago for the Packard Motor Car Co. The purpose of this design is to minimize the number of columns obstructing the floor area and to give ample light and ventilation throughout the central part. The floor area of nearly 90,000 sq.ft. is unusually large for a building of this character and necessitates special provision for effective lighting of the first floor, this being provided by two light courts 48 x 162 ft. Other notable features are the large ventilating skylights in steel truss monitors and the provision of a ramp or inclined driveway between the two floors.

This garage is 304 x 298½ ft. on the building line, with a height of 17½ ft. for the lower story and 16 to 17½ ft. for the upper story, the clear headway under the girders being about 14 ft. The typical column spacing is 38 x 33 ft., but at each light court one row of columns is omitted giving a 76 ft. space, with a 14 ft. cantilever shelf on each side and a clear opening of 48 ft. Along each side of the building the first interior columns are 18 ft. from the wall, forming bays 18 x 33 ft.

From the floor plan and section Figs. 1 and 2 it will be seen that the framing system consists of heavy girders of 33-ft. span running in one direction and having 38-ft. transverse beams between them, with cantilever brackets on four of these girders, the cantilever and beams being spaced 11 ft. c. to c. The heaviest girders, which are those carrying the cantilevers, are 24 x 42 in. and 22 x 42 in. in section with a span of 33 ft. The beams between these are mainly 12 x 34 in. All main interior columns are of circular section, rectangular columns being used at stairways and elevator shafts and for the ramp.

A 5½-in. floor slab is incorporated in the depth of the girders and beams, reinforced with ½-in. rods spaced 7½ in. c. to c. in one direction and ⅜-in. rods 18 in. c. to c. in the opposite direction to take care of temperature stresses. Both straight and bent bars are used in the girders and beams, as shown, the bent bars being continued into the adjacent spans. Stirrups of U-shape supplement the bars. All reinforcement is of plain

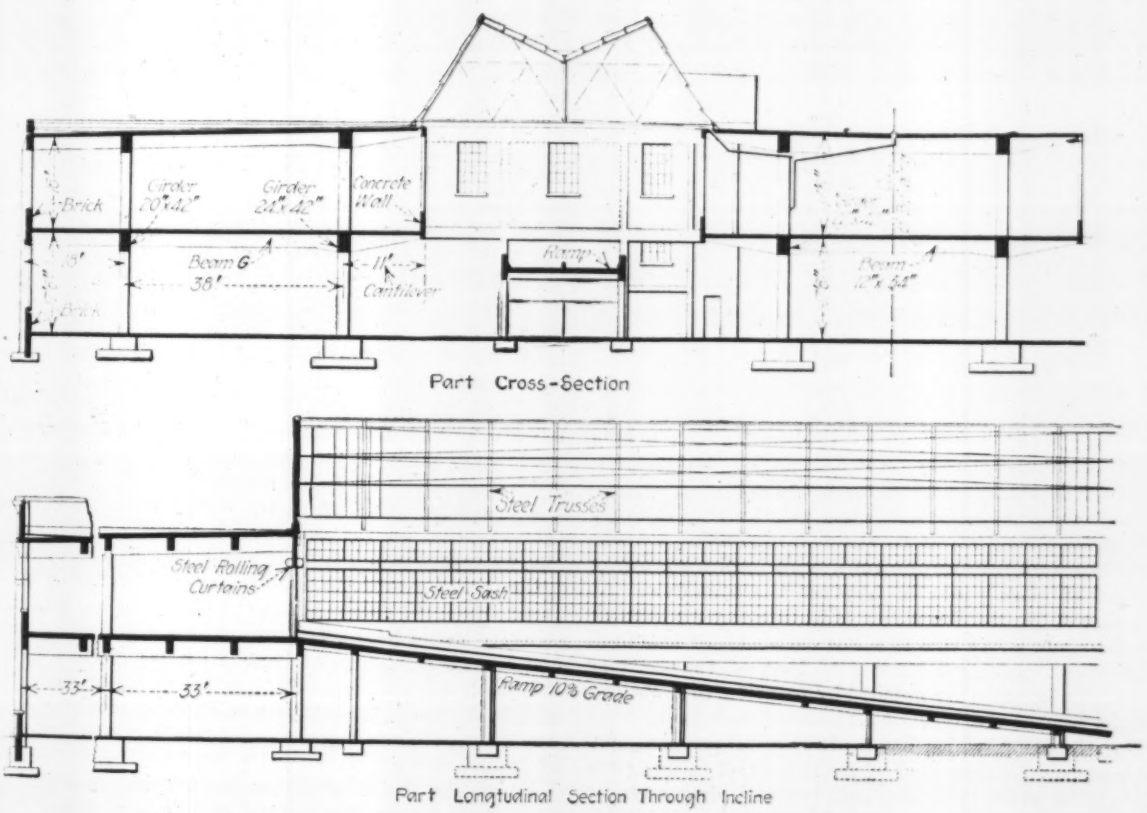


FIG. 1—CANTILEVER FLOOR AND ROOF CONSTRUCTION FOR GARAGE

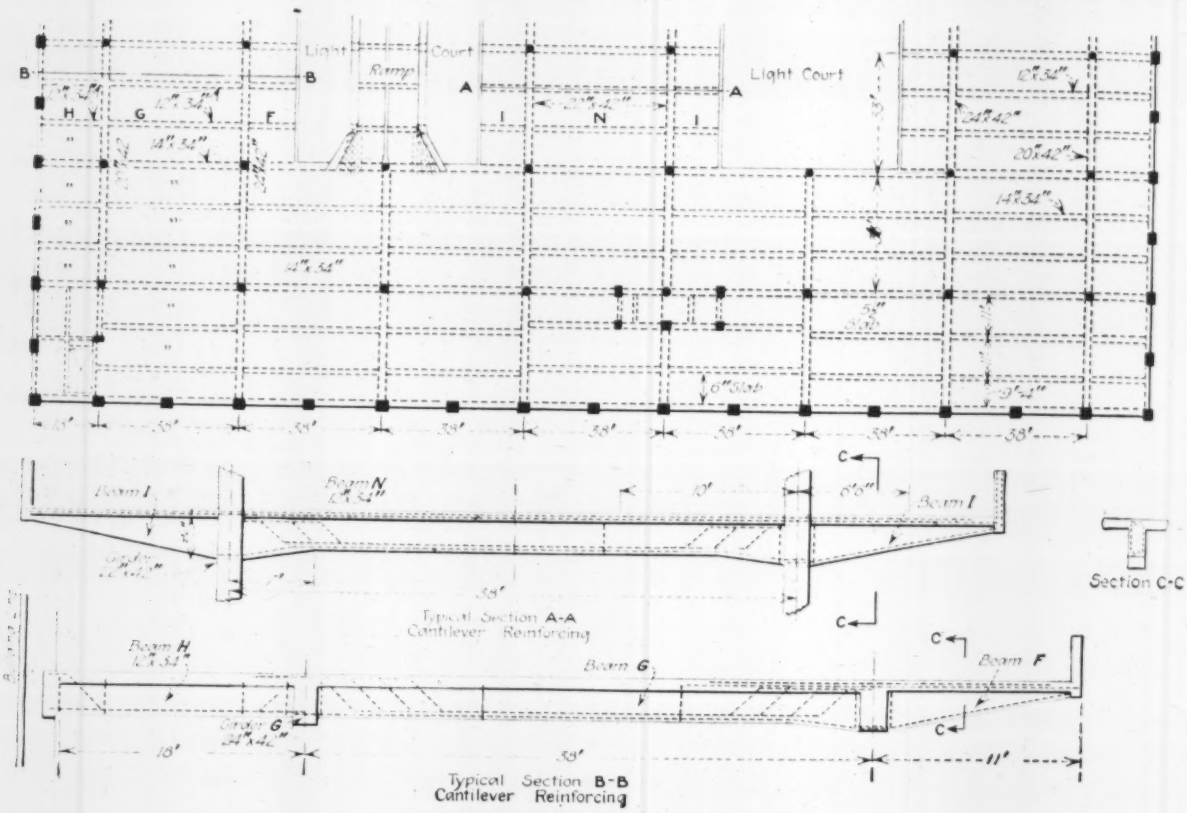


FIG. 2—PART PLAN OF FLOOR FRAMING

square bars, except that round bars are used for the ¼-in. size. The second floor is designed for a live load of 125 lb. per square foot. Holes in the beams are formed by 1¼-in. pipe sleeves to allow of placing overhead pipes and for attaching a light monorail system over one part of the floor. Inserts in the slab are spaced about 5½ ft. apart for the attachment of shaft hangers and other fixtures for the repair work equipment.

For the roof, the framing system is similar but with somewhat lighter sections and with a 4-in. slab reinforced by ⅜-in. bars of 8-in. spacing. Both the main roof and the monitors are designed for a live load or snow load of 25 lb. per sq.ft. A pitch and felt waterproof roofing is laid upon the slab.

Exposed concrete spandrels are reinforced for temperature stresses with ½-in. bars, the horizontal bars being spaced 24 in. and the vertical bars 12 in. c. to c. Brick spandrel walls are built above the concrete spandrels, the latter being below the floor slabs.

Steel sash is supported upon the brick spandrels, except that on the street front the sash framing extends from the first floor to the roof, with steel plate filling instead of glass panes in front of the spandrels. At the edge of the cantilever slab is a stiffening rib beneath the floor and above this is a low curb wall or spandrel, supporting steel sash similar to that of the exterior walls. These walls are finished by painting with factory enamel cement coating.

For the ramp, which has a grade of 10 per cent, column supports independent of the structural columns are used. The width is divided into two 9-ft. driveways by a central curb, but the parapet walls or girders are flared outward at top and bottom for the convenience of vehicles entering and leaving the driveways. This ramp is designed for a load of 125 lb. per sq.ft. A 5½-in. slab forms the floor and is finished with a roughened surface to give a good grip for the wheels. Stairs and passenger elevators are provided, but there is no car elevator.

Steel trusses of 48 ft. span and spaced 11 ft. apart form lofty monitors over the two light courts, the trusses being seated on concrete shoes or blocks on the ends of the 14-ft. cantilever brackets of the roof framing. The sides have steel sash and wire glass, with pivoted panels for ventilation. Cement tiles cover the top of the monitor, being supported on purlins of 6-in. channels.

Creosoted block paving is used on both floors, except at the spaces where cars are washed and cleaned, these spaces being of concrete shaped to drainage planes and finished to a smooth surface. A low and rounded curb around the edge of the concrete prevents water from flowing onto the floor but allows cars to pass over it readily. The wood blocks are laid directly on a paint coat of pitch on the concrete slab and pitch filler is poured over them.

Concrete for structural work was a 1:2:4 mix; made fairly wet and using ½-in. crushed stone so that the concrete would pass freely around the reinforcing steel and have a minimum of voids. Chutes from a tower outside the building and an auxiliary tower near the middle delivered the concrete to hoppers from which it was distributed by buggies. All reinforcement consists of deformed bars.

Forms for the sides of the large beams and girders were built up on the ground and hoisted into place, being fitted against cleats spiked to the 2-in. bottom of

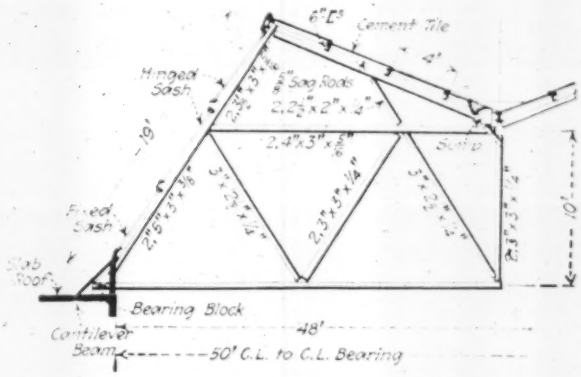


FIG. 3.—STEEL TRUSS FOR MONITORS OVER LIGHT COURTS

the form and held at the top by wiring and by the 2 x 8-in. joists of the floor forms, these joists being spaced about 16 in. c. to c. The forms were designed for easy removal so that they could be used over again. They were not lined nor were the interior surfaces oiled. For the supports, 4 x 4-in. posts were used, spaced about 30 in. c. to c. and having the usual T-head construction. Falsework was left in place for about two months after pouring the concrete, this being necessary on account of the work being done during the winter.

This building was designed by Albert Kahn, architect and engineer, Detroit, Mich., the structural design being worked out by J. T. N. Hoyt, chief structural engineer. The contractor was the Edward L. Scheidenhelm Co., Chicago.

Increased Salinity in Waters of the Lower Sacramento River

Irrigation and Potable Water Systems Face Permanent Problem — Remedies Suggested by T. H. Means

A SUDDEN increase of salinity in the lower reaches of the Sacramento River has presented new problems in those irrigation and domestic systems that depend on this source of water supply. When the tidal effects and the accompanying salinity were found to have passed all previous records and to be steadily moving still farther up the river, question arose as to what caused the change; whether it could be atributed to the diversion of water for irrigation, to the straightening and deepening of the channel, to the several years of drought or to other causes. At a meeting of the San Francisco Section, Am. Soc. C. E., held to discuss the situation, T. H. Means, consulting engineer, read a paper on the subject from which the following is quoted:

Carquinez strait is the outlet for the 45,000-sq. mile area of the Sacramento and San Joaquin River basins, the great interior valley of California. The discharge of the Sacramento River formerly varied from less than 10,000 sec.-ft. in late summer to over 500,000 sec.-ft. during floods. The San Joaquin Valley discharge probably varied between a minimum of 5,000 sec.-ft. and a maximum of over 300,000 sec.-ft. In 1919 the Sacramento at one time flowed less than 2,000 sec.-ft. at Sacramento and the San Joaquin delivered probably little in excess of 500 sec.-ft. The decreased flow in that year was due to the low run-off and to the large amount diverted for irrigation in all parts of the tributary watershed.

The low flow alone does not account for the encroachment of salt water. There probably never has been a time when there was not some fresh water coming down the streams, that is, the diversions in the delta have probably not exceeded the flow from the lower Sacramento and San Joaquin. The cause of the encroachment of salt water is the fluctuation caused by the tides. Tidal fluctuations at San Francisco vary from 3 ft. at neap tides to over 7 ft. at time of spring tides. Some effect of this tidal fluctuation was felt during the summer of 1920 as far upstream as the city of Sacramento on the Sacramento and above the mouth of the Stanislaus on the San Joaquin River.

The tidal prism above Carquinez Straits is approximately 75,000 acre-ft. for spring tides. During ordinary tides it amounts to perhaps 50,000 acre-ft. In other words a flow of about 100,000 sec.-ft. would be required to prevent a reversal of current in the straits. This amount of inflow occurs only a few days in the year, consequently the current usually reverses twice a day in the straits. The tidal movements rapidly carry water upstream and mix it with the fresh water coming down so that with each reversal of flow the salt water passes higher until a point is reached where the tidal prism above is equal to the quantity of fresh water coming down stream. Thus as the flow decreases, the salt water passes upstream.

Under present conditions the entire low flow of all the tributaries draining through Carquinez Straits is apt to be diverted every year, leaving practically nothing but the return seepage to pass down into the tidal portion of the rivers. Thus what was once a very rare occurrence, the appearance of salt water in the lower rivers, is now to be expected every year and for longer periods of time than formerly.

What Causes Inflow of Salt Water

Prior to 1918 salt water seldom reached Pittsburgh. In both 1918 and 1919, water at Pittsburgh and far beyond became brackish. This sudden change was due to large diversions made in the Sacramento Valley for irrigation purposes. In previous years the encroachments by irrigation had been so gradual that they were not noticed from year to year. The sudden large increase in diversions by the rice irrigators, coming in a series of relatively dry years and just at the point when the salt water limit was reaching upper Suisun Bay, combined to bring about a sudden change in lower river conditions.

New storage reservoirs are planned and spring floods will in part be prevented. The June rise from the San Joaquin tributaries is going to be lower and of shorter duration as more reservoirs are built. Future irrigation developments will increase the difficulties by decreasing the low flow. While return seepage will increase, it is not likely that it will ever amount to enough to keep salt water out of the lower island country. Undoubtedly unless something is done this region will henceforth face a salt water problem in most years.

Towns along the lower river must find some other source for domestic supply. At one time the lower Sacramento River at Rio Vista was proposed as a source for San Francisco and other bay cities. Salt water now goes miles beyond that proposed point of diversion. The problem of securing water for the tidewater towns has always been serious, it is now more so. There is little left for us to do but consider high mountain sources where storage is available. The fallacy of San Francisco going to the head waters of the Sacramento River and diverting low flow is now apparent. A larger acreage would have had to remain dry in the Sacramento Valley than will be deprived of water by Hetch-Hetchy storage. Good storage sites are not known on the upper Sacramento River.

Several remedies suggest themselves. They are:

1. Reduce the tidal prism by cutting off sloughs and shallow parts of Suisun Bay and completing the reclamation of the island lands. This will reduce the tidal fluctuations through the straits and lessen the up-flow of salt water. This will not be a cure, however, for salt water will continue to go far beyond its former limits.

2. Build a dam with tide gates to prevent up-flow of salt water. This suggestion has sufficient merit to warrant its serious consideration. It is not likely to prove feasible except at great expense. It does not look like a job for any but the Federal Government.

3. Build storage reservoirs and maintain a low flow, sufficient to keep salt water below the head of Suisun Bay. No suitable reservoir sites are known; surveys of the Sacramento watershed for this purpose are badly needed. Iron Canyon is not available for it is needed to supply the lands immediately below Red Bluff.

4. Allow salt water to continue its fluctuation and provide for the island country by diverting fresh water from some point above tidal fluctuation. This, too, will be costly, but in our present state of knowledge it is one of the promising solutions for the water supply for a part of the area.

5. A combination of the four suggestions above may provide for a large part of the island area. Even under the best conditions the cost will be large and in our present state of knowledge we cannot even suggest what it will amount to.

An investigation of the problem by impartial engineers should be made at once. Remedies should be investigated and recommendations should be made. The entire Sacramento and San Joaquin Valleys are interested in the outcome.

Road Work Speeded Up By Service Commission Car Orders

Pennsylvania Adds to Mileage by Request That Railroads Place Weekly 531 Cars for Cement, 1,439 for Aggregates

IN AN ENDEAVOR to assist in speeding up the highway construction program outlined for 1920 by the Pennsylvania State Highway Department the Public Service Commission of Pennsylvania issued, on July 12, the first of several orders directing the various railroads operating within the state to place at the disposal of the consignors of road materials enough box and open-top cars to fulfill needs of contractors having highway contracts with the state. Needs of contractors were based upon information secured in a questionnaire sent out some time previously by the Highway Department requesting data as to the amount of cement or aggregates needed, manufacturer with whom the contractor had placed his order, the point from which shipments should be made, and the point at which delivery should be made. Such questionnaires were sent to each of the 265 road contarctors doing state highway work. The order of July 12 was based upon more or less fragmentary information resulting from the circulation of this questionnaire, though supplemental orders dated July 26 and Aug. 7 were issued as more complete information was had from contractors.

Origin of Car Orders

Action was taken by the Public Service Commission after complaint was filed by the Pennsylvania Highway Department that its highway construction work was being maferially hampered through inability of contractors to secure materials. As most of the cement manufacturers, as well as firms supplying sand, crushed stone and slag, with whom road material contracts had been made prior to the pronounced car shortage, are located in Pennsylvania, the Public Service Commission considered that, in the interest of public safety, anything it could legally do to assist in the highway construction problem would be justifiable.

The commission's first order, calling for the distribution to various manufacturers of 474 box cars per week for the transportation of cement, specified the number of cars to be supplied by each railroad and also the point from which the shipments were to be made. The first order called for the following allocation of cars by the various railroads concerned: Pennsylvania, 186; Philadelphia & Reading, 124; Delaware, Lackawanna & Western, 65; Central Railroad of New Jersey, 18; Lehigh Valley, 48; Lehigh & New England, 21; Pittsburgh & Lake Erie, 6; Baltimore & Ohio, 6. This number of box cars was increased to 531 through the supplemental order of July 26, in which it was directed that the following railroads place at the disposal of various cement manufacturers the following number of cars weekly: Pennsylvania, 157; Philadelphia & Reading, 182; Delaware, Lackawanna & Western, 117; Central Railroad of New Jersey, 23; Lehigh Valley, 15; Pittsburgh & Lake Erie, 5; Baltimore & Ohio, 8; Bessemer & Lake Erie, 24.

For the transportation of sand, crushed stone and slag another supplemental order was issued on Aug. 7. That order directed the following railroads to supply various aggregate producers with the following number of cars per week: Pennsylvania, 703; Philadelphia & Reading, 167; Western Maryland, 118; Baltimore & Ohio, 161; Pittsburgh & Lake Erie, 51; Huntington & Broad Top Mountain, 38; Lehigh Valley, 69; Bessemer, 24; New York Central, 18; Buffalo, Rochester & Pittsburgh, 60; Central Railroad of New Jersey, 6; Erie, 6; Lehigh & New England, 18; making a total of 1,439.

Co-operation Only Sought

The State Highway Department points to the fact that the issuance of Public Service Commission car orders is merely a step toward closer co-operation between the Highway Department and the various railroads delivering highway materials. The statement is made by Highway Department officials that the various railroads involved have all viced an appreciation of the situation and pledged all assistance possible. The questionnaires circulated among the road contractors have been able to give the commission adequate information as to the exact amount of road materials needed. The car orders, it is asserted, is but one way of disseminating this information.

An accurate check is kept by the department of shipments necessary and those actually made, and the effect of the Public Service Commission orders has been noticeable in the amount of mileage constructed since the first order was issued. A statement of one of the officials of the Highway Department is to the effect that the mileage has been more than quadrupled since July 12.

At the same time the information was sought of the various road contractors as to their actual needs, a letter was sent to each contractor in which it was urged upon him to unload cement and aggregate supplies as soon as possible. In fact, the statement was made by the Highway Department that unless cars would be unloaded within 24 hr. little co-operation could be expected from the Highway Department. The questionnaires requesting information applied not only to cement and aggregate, but to other road building materials—brick, asphalt and tar.

Besides the number of cars necessary to transport cement and aggregates for building Pennsylvania high-

ways, another idea may be gained of the size of its program by the assertion of one of the highway officials that this year's program called for the construction of 600 mi. of reinforced-concrete highways, for which approximately 2,500,000 bbl. of cement would be necessary.

Model Industrial Town Layout at Marysville, Mich.

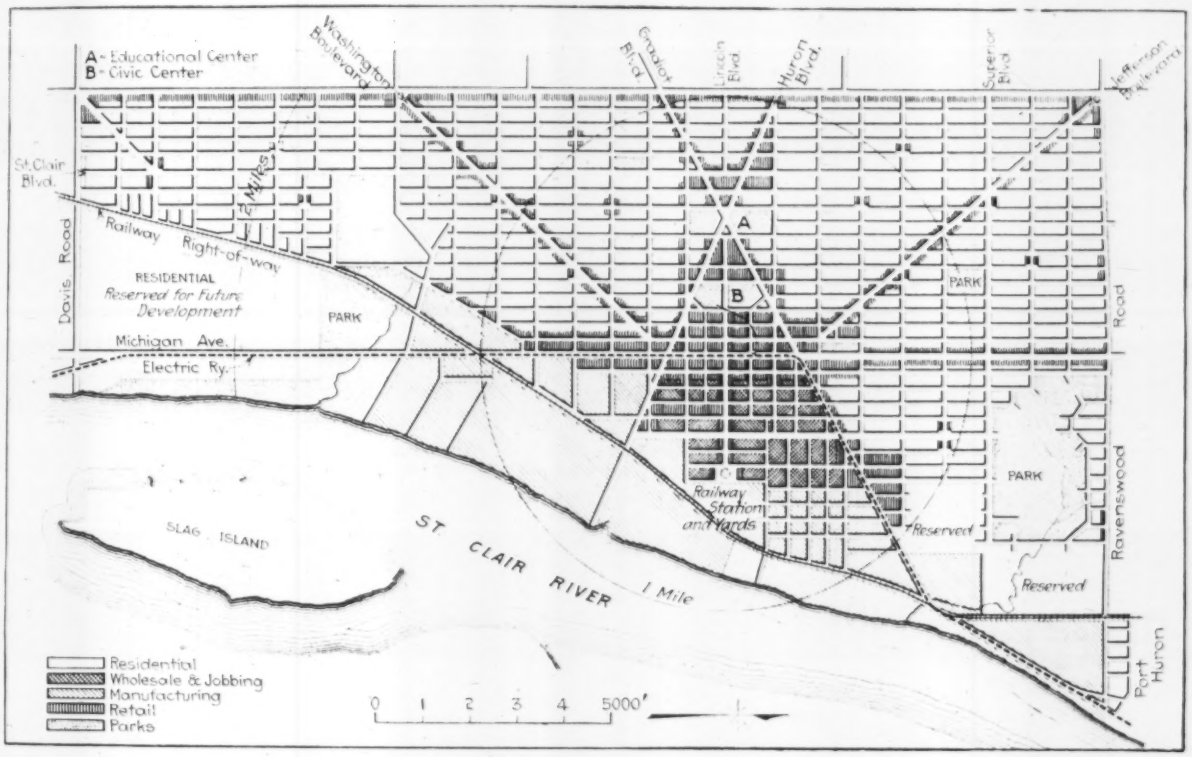
Zoning Combined with City Planning—Site Was Farm Land—Public Utilities, Parks And Civic Center Provided

AN INDUSTRIAL city for a population of 150,000, designed with equal consideration for social and commercial aspects, has been laid out at Marysville, Mich., which was formerly a village of about 150 inhabitants. This enterprise has been undertaken by C. H. Wills in connection with the establishment of a large automobile factory at this point. It was Mr. Wills' idea to have the plant so located that it could be served by railroad and water transportation; also that there should be sufficient property available for the construction of other plants making automobile accessories, as well as sufficient room for the proper housing of employees and other people necessary for a manufacturing center of the size required, all of which would form the nucleus of a future city.

With this thought in mind the new Marysville has been planned with a system of streets, parks and boulevards and with zones for residential, business and manufacturing districts in proper relation to each other so that the future would be free from the troubles of many cities where corrective measures are being taken to overcome faults produced by haphazard street systems and uncontrolled growth.

Marysville is about four miles south of Port Huron on the west side of the St. Clair River. The property purchased by Mr. Wills covers about 4,400 acres, in a parcel four miles long and from 1½ to 2½ miles wide. The accompanying map shows the general outline of the property, which includes the old village of Marysville and a smaller community called South Port Huron. The ground rises rather abruptly at the river front and slopes gradually from the river, affording natural drainage, the soil containing gravel over clay. Two creeks within the area are made part of the park system.

The Port Huron Southern R.R. runs through the property, as shown, but the right of way has been increased to allow other railroads access to the factory districts and to confine them all to one route across the town, with grade separations at the principal streets. An electric line of the Detroit United Ry. provides electric interurban car service along the river front, but its route will be changed to Michigan Ave. and Gratiot Road, connecting at the north end with the original line. In the street system provision has been made for future transportation requirements.



LAYOUT OF NEW INDUSTRIAL TOWN OF MARYSVILLE, MICH.

In designing the street layout it was necessary to retain certain roads, such as Gratiot Road, Huron Boulevard, Michigan Boulevard north of Huron, James Boulevard and the northwest and south boundary line roads. As some of these are township roads and Gratiot Road is an old military road, their direction could not be changed.

Factory sites are located between the river and the railroads, reserving a large portion of the river front-

age for the park system and for future residential development. The retail business center is on Michigan Ave. between Gratiot and Huron boulevards. With the addition of two diagonal streets, Washington and Jefferson boulevards, the existing roads form a radial system that reaches all parts of the property. The radial streets do not converge at one point, as this would concentrate traffic and create a bad condition. Instead, they have been kept a half-mile apart, with some of the radial streets split before they reach the centers. To handle this diverted traffic the adjoining streets east and west have been widened. At and between the above-mentioned centers the future retail district will develop.

West of the business district a space has been reserved for a civic center fronting on two main boulevards and connected to the business district by a third—Lincoln Boulevard—which extends to a space reserved for the railway passenger station. The wholesale, jobbing and market district is convenient to the railway freight yards and the retail districts.

The remaining territory has been utilized for residential purposes, away from the business districts and on the higher parts of the property. This area has been laid out on a combination of the gridiron and radial street system, as indicated on the map. A little study of the street system will show the convenient access from one part of town to another. The main radial streets which will handle the heavy traffic of the future are 100 and 120 ft. wide, permitting a planting space through the center until increased traffic requires its removal. For residence streets a general width of 80 ft. has been adopted for streets running east and west, and 60 ft. for those running north and south. Asphalt paving probably will be laid eventually, but at present the streets are being laid mainly with cinder beds.

Topographical conditions governed the location of the park system, preserving the best of the wooded areas and serving the residential districts. Large parks are located near the north and south of the property, with smaller parks one or two blocks in area provided at various points throughout the residential and business districts. In addition, the boulevards have been provided with parking in the center and at the junction of the diagonal thoroughfares with the cross streets planting spaces have been arranged. This park system is linked up by a boulevard system with Superior Boulevard on the north and St. Clair Boulevard on the west, thus connecting all the radial streets, which will be planted like the boulevards. The boulevards extend to a large piece of property at the south, reserved for future residential development.

Residential lots, generally speaking, are 40 x 120 ft., on 60-ft. streets, with 45- and 50-ft. lots on the 80-ft. streets and boulevards. In the business districts the lots are 20 x 100 ft. Alleys have been omitted in residential blocks, but an easement has been provided and so arranged that alleys may be formed if future residents desire. A comprehensive plan of zoning has been provided, as indicated on the map. Properties are being sold subject to restrictions for use according to this zoning. Aharbor line has been established, so that future factories may take advantage of the ultimate development along the waterfront.

Water supply is obtained at present from the Port Huron system, but independent water-works are contemplated, with an intake from the river and a filtration plant. The sewer system is to have mains running east and west in about every fourth or fifth street, with laterals extending north and south. These mains will connect with an intercepting sewer near the river front, leading to disposal plants.

Apart from the laying out of many streets and lots, the construction has been confined to the plants of the American Bushings Co. and the Athol Manufacturing Co. and the first units of the new plant for Mr. Wills, which is expected to be in production in a few months. To take care of the employees of these factories a considerable number of single and multiple houses have been built and others are under construction in the various subdivisions, as well as the necessary roads, sidewalks, sewers and water mains in that part of town where the first developments are being made. About 135 residences, mainly of frame construction, have been built and both residences and business buildings are under construction. At the end of August, 1920, the population was about 1,000.

This new town site occupies property which was farm land a year ago. With a comprehensive plan adopted and proper action taken during the next few years to see that the ideals developed in the town plan are carried out consistently, it is expected that Marysville will develop as a model town. All the town planning, engineering design and architectural work for the project are in the hands of Smith, Hinchman & Grylls, architects and engineers, Detroit, Mich.; L. R. Hoffman is the engineer in charge. Construction work has been done by the Walbridge-Aldinger Co., of Detroit, under the direct supervision of the owner's staff.

Railroad Tie Production and Demand

The normal demand for railroad ties is somewhere between 100 million and 125 million annually, says the recent United States Forest Service report compiled in response to the Capper Resolution in the Senate. In 1918, purchases were slightly under 77,500,000 according to the report, and in 10 months of 1919, were slightly over 84,500,000. During the war and the period of Government supervision of the railroads, extensions could not be made and improvements were necessarily confined to those of an urgent character. Lumber purchases were therefore at a minimum. Even under such a policy of retrenchment railroad purchases of sawed materials, excluding hewn railroad ties, telephone poles, etc., aggregated approximately 4½ billion feet or 14 per cent of the total lumber cut of the country for 1918. That there have been profound changes in the lumber distribution from different regions during the past year, continues the report, is shown by the invasion of the Middle Western and Eastern States by Dogulas fir ties. These are regions which in the past have been supplied with the standard oak tie cut immediately along the rights of way or with southern pine ties from the South. During 1919 orders amounting to nearly 100,000,000 board feet were placed for Douglas fir ties for eastern roads because of the uncertainty of securing adequate supplies along their rights of way and because of the excessive costs of local ties. In other words, oak ties cut within a few miles of the right of way are now being replaced by fir ties hauled overland.

Notes from Foreign Fields

ENGINEERING ACTIVITIES IN SWITZERLAND

By E. J. Mehren
Editor, *Engineering News-Record*

BEFORE the United States entered the war we had experienced disturbed industrial conditions. It is therefore easy to appreciate that Switzerland, hemmed in by belligerents, must have suffered, even though a neutral. The cost of living is now between two and three times the pre-war rate, while some articles cost four times as much as before. Common labor has risen in price from 50 centimes per hour (9½ cents) to 1.40 francs (27 cents). The corresponding figures for skilled labor are 80 centimes and 2 francs. Before the war, 10 hours was the working day; now it is 8, and while working production is at only two-thirds the pre-war rate.

In general, then, Switzerland, a neutral, is contending with the same difficulties as the former belligerents. To complete the sum of its troubles there is housing shortage and there have been a goodly number of strikes.

The Swiss franc stands at 18 cents (American), less than 2 cents below par and the exchanges with other nations are nearly normal. That enables Switzerland to continue buying on more favorable terms than the belligerents.

On account of high wages and material prices, however, there is relatively little construction, excepting in railway electrification and water-power development. In addition, the second bore of the Simplon tunnel is being completed.

The water-power construction is the result of the rapid and great increase in the cost of coal. Developments not economical under pre-war coal prices, are economical today. The Swiss Federal Railway System (*Staats Bundesbahnen*) has under way three high-head developments, one of which, the Ritom plant, will be in operation before this is printed. In addition, two large plants for general electric service have just been completed, one at Eglisau (38,000 hp.) on the Rhine, and the other at Mühleberg (64,000), on the Aar, near Berne.

With the likelihood of coal prices remaining high, additional water-power developments may be looked for. The government estimates that the total net horse-power (15-hour power) developed and capable of development is 4,000,000. Of this total only 720,000 hp. have been developed, or about 18 per cent.

Ritom Power-Plant—The Ritom plant, to which reference has been made, takes water from a small lake lying roughly 800 m. above the floor of the Tessin Valley. A tunnel of only 900 m. (2,952 ft.) brings the water through the mountain to a point above the turbine-house. Thence steel pipe lines lead down to the wheels. The storage at the lake has been increased by a dam 7 m. high, and the tunnel is at such a nelevation that the available draw-down capacity is 23,000,000 cu.m. The operating head will vary from 820 to 800 m. (from 2,690 to 2,624 ft.). Pelton wheels of 12,500 hp. capacity, built by Piccard, Pictet & Co., of Geneva, are used. The current will be used for the electric operation of the St. Gotthard tunnel and the adjoining line north and south. At present four wheels are installed. Two will be added later.

At Amsteg, just north of the St. Gotthard (the Ritom development is at Ambri-Piotta, just south of the tunnel) the Federal Railway System has a 280 m.-head plant under construction. The water of the Reuss is to be led through a tunnel 8 km. long, and then dropped through steel pipe lines to the wheels. The plant will have a capacity of 90,000 hp.

A third development for the railway system has just been taken in hand in the western part of Switzerland, but progress there will be slow since the snow conditions

FIG. 1. ELECTRIC LOCOMOTIVE FOR THE ST. GOTTHARD TUNNEL LINE
Traffic through this tunnel has just now been put under electric operation.

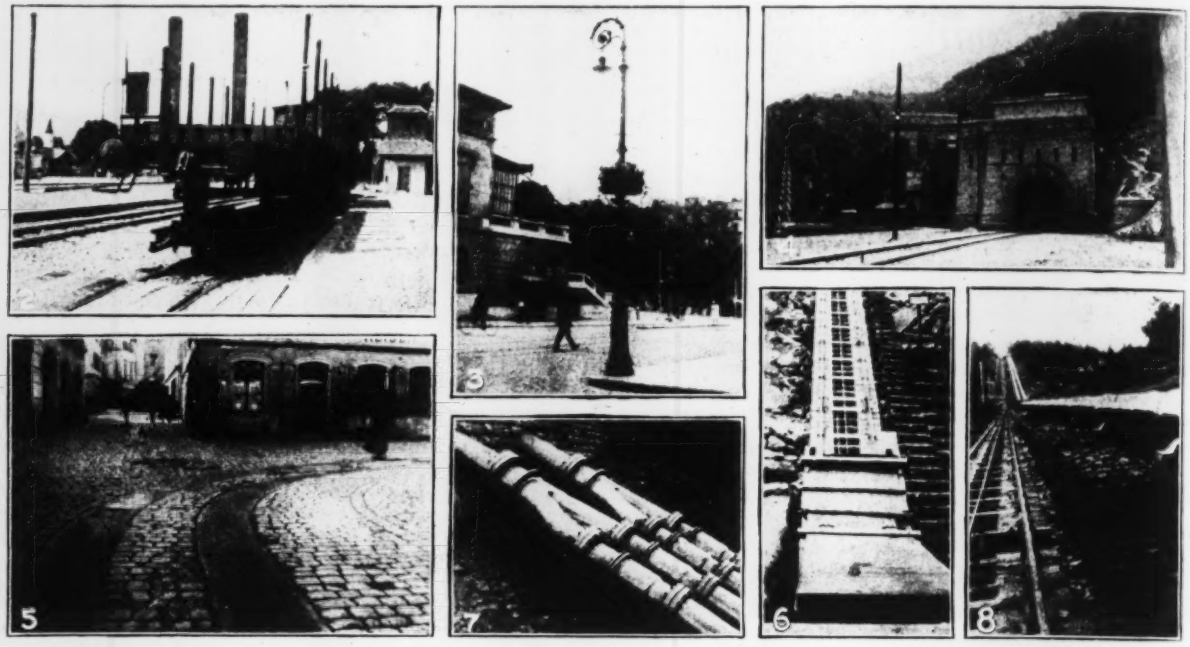
are such that work can be carried on only five months in the year.

The other plants referred to operate under lower heads, Eglisau under 11 m., Mühleberg under 20.

In this connection it is worth while noting that the highest head plant in Switzerland (in operation some years) is the Fully plant, at Martigny, where the head is 1,635 m. (5,363 ft.).

Railway electrification is actually under way in Switzerland, whereas in some of the other countries of Europe, where much talk is heard about it, it is still in the project or preliminary stages. In Belgium, for example, an electrification commission is at work, but a report carrying recommendations has not been rendered. France is further ahead; a commission representing the government and all of the interested railroads has, after studies in England, the United States, Italy and Switzerland, advised that all electrification there be direct current, 1,500 volts, after the pattern of our Chicago, Milwaukee & St. Paul. However, no electrification work is actually under way. In Germany, on the other hand, the Bavarian Goverment has well in hand a large hydro-electric plant which will supply current for railway electrification.

In Switzerland the work is proceeding apace. In 1918 the line from Berne to Thun, 31 km., was electrified, using the single-phase system, which has been adopted as standard for all future Swiss Federal Railway electrification. During the war, however, there was surplus power and surplus equipment available from the Simplon development and a 53-km. stretch from Brigue to Sion was electrified, using 3-phase current, the same as used in the Simplon tunnel. This is a temporary installation, and will be changed later to single phase. It is not the intention, however, to do away with 3-phase in the Simplon tunnel, for when the Italian electrification joins up with the Swiss, 3-phase current will be used on the Italian lines. That is due to the extensive development



2. STANDARD-GAGE FLAT CAR CARRIED ON NARROW-GAGE BOGGY. 3. FLOWERBOXES ON ELECTRIC-LIGHT POST—AN INTERESTING TOUCH IN GENEVA. 4. PORTAL ON RIGHT IS THAT OF SECOND SIMPLON TUNNEL. 5. STONE WHEEL TRACKS, ALTDORF. 6. CAR ON RITOM SERVICE RAILWAY. (Seated on the back of this car, with an Italian workman as companion, the writer had a ride up the mountainside, rising 2,624 feet. The view over the Tessin Valley can never be forgotten.) 7. DIVISION IN PIPE LINES, RITOM HYDRO-ELECTRIC DEVELOPMENT. 8. INCLINED SERVICE RAILWAY AND PIPE LINES, RITOM HYDRO-ELECTRIC PLANT.

of 3-phase power on the Italian side of the Alps.

While I did not have opportunity to enquire thoroughly into the present electrification experiences on the Simplon line I gathered, not only from the decision to use single-phase on the other lines, but also from rather disparaging remarks about 3-phase equipment, that the 3-phase system has not lived up to expectations.

The electrification work actively in hand (and to be finished this year) is the two-track section from Erstfeld to Bellinzona, which includes the St. Gotthard tunnel. On this section maximum grades of 2.7 per cent are encountered. The tunnel portion itself was practically completed several weeks ago, and before this is printed will be electrically operated.

The short stretch from Bellinzona to Chiasso, where the connection with the Italian lines is made, should be finished next year, while either next year or the year after the section from Erstfeld to Lucerne should be in electric operation, thus giving a 226-km. electrified stretch between Lucerne and Chiasso.

The other large construction job under way in Switzerland today is the completion of the second Simplon Tunnel. When the original bore was driven, a small ventilation tunnel (3 m. wide, 2.5 m. high, and 17.5 m. on centers from the first tube) was driven on the center line of the future second tunnel. This bore, which serves the purpose of a heading is now being enlarged to full section. Of the total length of 19.8 km. (approximately 12.3 miles) all but about 3 km. are finished, while of the unfinished stretch there is left not more than about 1,500 m. to be blown out to full section. The new tunnel from the Swiss portal to the center is completely finished, track laid and overhead installed for electric operation. On the Italian side for a distance of 7 km. the section is completed and lined but neither track nor overhead are installed.

Work on the second tunnel was started from both ends in 1914. After Italy entered the war the labor supply on the Italian side became unsatisfactory and in 1917 it was found necessary to shut down the work there. Progress continued from the north, however, until August, 1918, when the effect of the war upon Swiss conditions became such that all work was suspended. In November, 1919, construction was resumed, and with the present rate of progress the second bore should be in operation early in 1922.

In the driving of the second tube much of the difficulty that was experienced in the first work has been repeated. Large flows of water have been encountered, some with temperatures up to 60 deg. C., (140 deg. Fahr.) while bad rock under heavy pressure has been common. Naturally, the experiences developed in the first work have been invaluable and the driving accordingly has gone on with far less anxiety than did the first operation.

Tourists—In one respect the visitor to Switzerland at present fails to get a normal impression. One of the chief pre-war businesses was tourists. With the adverse exchange in the neighboring countries only war profiteers can afford to go to Switzerland. English exchange is in better condition, while Americans find exchange in their favor. However, there are relatively few English people here and Americans are almost rare, so that the hotels are deserted. In fact many of the large ones have not opened at all this year. This merely adds to the sum of Switzerland's difficulties referred to in the opening paragraphs of this letter.

Despite her troubles, however, she is in much better condition than the other countries I have visited, and with a currency in good shape and with a population not exhausted by a long war strain, her difficulties will disappear long before those of her neighbors.

Zurich, July 8.

LETTERS TO THE EDITOR

Members Pledge Support for Am. Soc. C. E. Administrative Reforms

Sir—Amplifying our recent appeal to the membership of the American Society of Civil Engineers for a progressive as against a radical policy for the society, we endorse and pledge ourselves to support the following administrative reforms:

A. The creation and strengthening of the local section as an essential part of the structure of the society.

B. The selection of directors by the districts they are to represent.

C. A progressive policy as regards the duties and obligations of the society as well as the broadening and strengthening of its technical and professional activities.

To accomplish these purposes we again urge the defeat of Amendments A, B, F, and G, so that in their place there may be adopted progressive amendments that will accomplish these essential reforms without incurring the dangers to the standing and stability of the society that lie in the amendments now before it.

We furthermore pledge ourselves to the introduction of such amendments as may be necessary to accomplish these objects.

We repeat and emphasize that this appeal is on behalf of the great body of the non-partisan membership of the society which stands for genuine progress and which is not allied with or interested in any faction.

E. S. ALDERMAN.
W. E. BALDRY, W. L. BENHAM, L. E. BISHOP, R. D. BLACK, W. G. BROWN, W. V. BUCK, L. BUSH.
F. W. CAPPELEN, W. T. CHEVALIER, V. H. COCHRANE, M. L. CUNNINGHAM.
P. A. DALLIS, J. V. DAVIES.
T. EARLE, F. W. EPPS, A. C. EVERHAM.
R. FLETCHER, G. W. FULLER.
A. L. GARNEY E. M. GRAHAM, R. C. GRAY.
J. L. HARRINGTON, F. D. HARTFORD, E. M. HASTINGS, J. H. HAYLOW, A. HAZEN, J. P. HOGAN, C. A. HOLDEN, C. M. HOLLAND, R. HORTENSTINE, E. E. HOWARD.
R. H. JACOBS, F. G. JONAH.
F. M. KERR, V. H. KRIEGSHABER, K. B. KUMPE.
H. A. LANE, G. H. LELAND, E. E. LOCHRIDGE, G. L. LUCAS J. L. LUDLOW.
A. MAITLAND, JR., R. R. MARSDEN, J. S. MEANS, C. A. MEES, R. A. MEEKER, R. MESSER, A. N. MILLER, B. S. MORROW, E. T. D. MYERS, JR.
W. R. NEEL, A. M. NELSON.
I. W. PATTERSON, J. N. PEASE, J. H. POLHEMUS.
F. M. RANDLETT, A. O. RIDGWAY, J. G. ROSS.
N. H. SAYFORD, W. C. SHAW, JR., W. F. SHULZ, L. K. SHERMAN, J. W. SMITH, L. B. SMITH, H. A. SUMNER, R. S. SUMNER.
J. L. TIGHE, L. R. TILLOTSON, H. P. TREADWAY, A. A. TROCON, R. D. TRIMBLE.
N. E. WIDDELL, G. S. WALSH, H. A. WELLS, H. F. WIEDEMAN, J. R. WILBANKS, P. B. WINFREE, F. E. WINSOR, C. C. WITT, D. WITTEN.
J. J. YATES.

[It is stated by the authors of the foregoing communication that lack of time has prevented the receipt for inclusion in this week's issue of additional signatures from the original signers of the appeal.—Editor.]

Reply to President Davis on Am. Soc. C. E. Amendments and the "Appeal"

Sir—In *Engineering News-Record* of Sept. 16, p. 570, appears a letter from President Davis of the American Society of Civil Engineers in which he attempts to discredit the appeal recently circulated by 182 representative members of the society, whose earnest hope is to save the society from the radical program embodied in some of the proposed amendments.

It would be well in the first place to correct any misapprehension that may be aroused by President Davis' reference to the "partisan author" of the "Appeal." It is too bad that he was not more specific on this point, for as it stands the reference means just exactly nothing at all. It is pure assertion, wholly unsupported, and not borne out by the Appeal itself. As such it will not command the respect of open-minded readers.

But it seems to me that the authorship of the Appeal is unimportant. What does matter is the endorsement it has received. I count 182 names subscribed to that Appeal. More than 60 of these are from west of the Mississippi. I see names from Montreal, Boston, San Francisco, Seattle and many cities and towns between. This group is larger and far more representative of the Am. Soc. C. E. than was the Portland convention to which President Davis alludes. The man would be rash indeed who would characterize it as sectional, partisan, or reactionary. These signers doubtless represent diverse shades of opinions on many subjects, but they have been drawn together by a common purpose that is deep enough and strong enough to submerge all other considerations. That purpose is the preservation of the Am. Soc. C. E. from the dangers that lurk in some of the proposed amendments. It seems to me that the members of the society may rest assured that the Appeal is just exactly what it professes to be—the appeal of a representative and non-partisan cross-section of the membership which has no purpose but to preserve the society from domination by any faction of whatever complexion.

But let us turn back to the letter. It is too bad that in writing it President Davis has not taken just a little trouble to get all his facts straight. He states, for example, that the Portland convention ordered the amendments to letter ballot by a vote of 73 to 13. If the proceedings of the convention have been correctly reported that vote had nothing whatever to do with the amendments, but dealt with the new federation.

Of even greater significance and far more practical importance is President Davis' statement that the amendments "commit the society to no additional expense." If this be true, I should be interested to learn the source of the funds that are to pay the "travelling expenses within continental United States on a mileage basis" for the delegates to the Annual Conference provided for in Amendment G.

In this connection it is interesting to observe that Prof. Gardner S. Williams estimates that there would be "100 or more" such delegates. At the conservative estimate of $150 each on an average for expenses, it appears that this one item alone will call for at least $15,000 per year for purely political purposes.

I cannot understand the meaning of President Davis' statement that "paragraphs D and E of the Appeal absolutely cancel each other" and that "both cannot be valid." Those paragraphs have nothing to do with each other. D refers to the proposed Annual Conference while E has to do with the Local Sections. If President Davis can explain how these "cancel out" and why both "cannot be valid" he is indeed a wizard of logic.

In his paragraph B President Davis ventures that it is "fair to assume" that there are no defects of inco-ordination, inconsistency or ambiguity in the amendments because they were not pointed out in the circular Appeal. His assumption is neither fair nor valid. Several such defects were clearly pointed out at the New York meeting of Sept. 1 and were published in the Sept. 9 issue of *Engineering News-Record*. It is needless to rehash them here. It looks as though President Davis had found one of them for himself, for he rushes to cover in the wired postcript to his letter (see last week's issue, p. 573) by showing that, very luckily, a holdover director would be available to fill the breach until a new amendment could be adopted to make good the oversight. As it is, the adoption of the amendment would require a unanimous vote of the board to elect new members for several months until the new amendment could be put into effect. But it was a close shave, and an excellent indication of the poor articulation of the amendments with the existing constitution.

President Davis makes much of the methods by which the amendments passed the Portland convention in his effort to show "mature consideration." It all sounds good enough as he tells it, but let us look for a moment at the realities. The Portland convention included less than 2 per cent of the membership of the society. It was one of those bodies which, in the words of Prof. Gardner S. Williams, "are never representative of any but the members in the

immediate vicinity of the place where the meeting is held or of a few devoted ones who make a commendable practice of attending all such meetings." In this case there were relatively few of the latter. The committee which "considered and co-ordinated" the amendments had them in hand not more than three hours.

President Davis drags a red herring across the trail when he talks of the Development Committee and the questionnaire. They had nothing to do with the amendments; they dealt with general principles and ideas, not with the machinery which should carry them into effect and which shall be carefully co-ordinated with the constitution of the society.

All this does not create the impression of "mature consideration" such as should be given to a matter of such vital importance and I sincerely hope that the appeal will be heeded and an opportunity given for the adoption of sound and well-considered amendments.

It is too bad that President Davis must fall back on the classic resource of factional politics, i.e., the stirring up of sectional prejudice. A disproportionately large part of his letter is devoted to the justification of the proposed shake-up of directors. He dwells upon the "unfairness" of the present representation. He reckons by the formulæ of civic politics and seems to be little interested in the efficient administration of the society. Perhaps there *are* more directors in the Metropolitan District than would be justified by numbers. Perhaps the number might be scaled down. But the headquarters of the society are there, and its business must be conducted there. Several of its committees must function there. *The prime consideration is the efficient management of the society, not numerical representation.* The Am. Soc. C. E. is not a state, with police power over the affairs and the lives of its members. We can carry worship of this "democratization" fetich to an extreme that may be theoretically ideal but will certainly be injurious in its practical application. If the present apportionment of directors effects an "unfair domination of a minority" then correct it, but in the name of the Am. Soc. C. E. do it in a way that will minister to efficient management rather than to sectional prejudice.

It is useless to go on into more detail. The amendments are a sad mixture of what is good and what is vicious. As they stand we cannot accept the one and reject the other. There is but one safe course. Reject those having to do with the administrative reforms, viz., A, B, F and G, and let us formulate a new plan that will include the essential reforms without danger to the welfare of the society.

In his last paragraph President Davis insinuates a charge for which there is not a scintilla of foundation. The Appeal conveys no threat of any sort and as one of the signers I wish to protest his statement. I am confident that the standing and character of the other signers carry their own refutation of the charge. WILLARD T. CHEVALIER.

New York City, Sept. 20.

Effect of Increased Rates on Railroad Construction

Sir—On my return after several weeks' absence I found your letter asking certain questions as to my views as to what will be done by the railroads in the way of improving transportation facilities within the next year. This is a pretty hard question to answer, owing to the peculiar financial situation and difficulty in securing material from the manufacturers.

A great deal of complaint has been made regarding slow delivery and inadequate transportation. Our experience on this railroad is that we are having difficulties in getting the material delivered from the manufacturers. There has never been a year before this in which we have had the difficulty that we have this year in getting track fixtures such as bolts, spikes, nut locks, joints, tie plates, frogs, switches and guard rails. It is hard to plan and carry out improvements promptly under the present conditions in connection with the securing of material.

With the exception of a few companies with high credit, railroads are up against the proposition of financing on a seven or seven and one-half per cent basis. There are many improvements on which, under the Transportation Act, they will receive at the most but six percent and will not receive this until such a time as some future adjustment in rates is made to include the value of the railroads, due to the addition and betterment charges that have accumulated since the tentative value set by the Commission.

This means that the class of expenditures that the average railroad can afford to make are those which will make for an economy in operation that will at least make up for the difference between six percent and whatever they have to pay for their money, and in addition to that which will make economies that will take care of the total expenditures between the time they are made and the time that readjustments of rates is made to cover this expenditure.

There will be improvements to the extent of the money that can be secured from the revolving fund created by the Transportation Act, but this will probably be along the lines of additional motive power, rolling stock, the purchase of labor saving tools and machines and of new rail, ties and ballast to make up for the shortage of these items during the period of Federal control.

Expenditures in addition to these that will be made first will probably be for the extension of passing tracks and additional passing tracks, due to the increase in business during the last three or four years. It is my thought that but a small part of these expenditures, however, will be made during the balance of the present year, but that they will be included in the budget of the different railroads for 1921.

There is a possibility that the rates which have been allowed by the Interstate Commerce Commission will permit of some roads, and possibly many roads, earning more than six per cent. The result of these rates will not be well enough known to decide this matter until after Jan. 1.

Should the earnings under the rates show up well the railroads will be warranted in making much needed improvements, due to the improved credit on the basis of such earnings. Should this turn out to be the case it is my opinion that there will be during 1921 much improvement made by the railroads in increasing terminal facilities as the greater majority of the roads have outgrown many of their terminals.

The changes in working conditions brought about in connection with the increased wage scale is going to require a large expenditure on the part of the railroads in better housing facilities for their employes, and there will be, in my judgment, large expenditures made if the money is available for this purpose. However, with the money available for improvements it is my opinion that the progress that can be made on these improvements will depend to a great extent on the ability of the manufacturers to furnish material and equipment needed.

Regarding the question of expansion of the engineering departments, this depends entirely upon the size of the program. Any marked increase in construction programs will, of course, call for an expansion of the engineering department.

As to the difficulty of transporting materials, it is my opinion that by the spring of 1921 the increase in locomotives and rolling stock, together with the overtaking of the deferred maintenance on the old locomotives and rolling stock will make a marked improvement in the transportation facilities, and that there will be no great difficulty in handling the business after about May 1, 1921. But with the provision of improved yard and engine terminals and with the additional passing tracks and second tracks that will be constructed there should be a continual improvement in transportation for the next two or three years.

Chicago, Sept. 8. C. A. MORSE, Chief Engineer,
Chicago, Rock Island and Pacific Railway Co.

[Letters on this subject from A. O. Cunningham, chief engineer, Wabash Railway Co., and L. C. Fritch, vice-

president, Chicago Rock Island and Pacific Railway Co., appeared in *Engineering News-Record*, Aug. 26, 1920, p. 424.—EDITOR.]

Applied Statics for the Rodman

Sir—You may be interested in the accompanying photograph as an illustration of labor-saving methods in field

work. I understand that the chair is a part of the regular equipment of the rodman shown. CHARLES W. SHERMAN.

Boston, Sept. 13.

Chinese Irrigation Devices—Overshot Wheel and Treadmill

Sir—In the article on water supply for irrigation in China in *Engineering News-Record*, Sept. 2, p. 448, D. F. McLeod has not mentioned the well-known device, "treadmill," used in the southern part of China. A tread-mill is, doubtless, more elaborate, ingenious and efficient than any of the three devices mentioned by Mr. McLeod. It is similar to an overshot wheel, working as a pump, set in an inclined position to suit the lift of the water required. The operator or operators tread the projecting arms of the axle, thus turning the vanes and lifting the water through a trough. This device has the advantages of maintaining a continuous flow, being workable by one or more operators, having an adjustable lift of water and keeping the feet of operators dry. In many cases it is operated through the connections of wooden gears and wheels, by animals on nearby land. The device described by Mr. McLeod as of Japanese origin has principles similar to those of a tread-mill and the tread-mill may also be used by Japanese farmers at present. C. Y. HOU.

Pottstown, Pa., Sept. 19.

Driest Season at Panama

Sir—In your issue of August 5th, page 276, article on "Driest Season at Panama," there is almost an obvious typographical error.

The 5.24 ft. drop in Gatun Lake storage from El. + 87.0 represents 20.46 billion cu.ft. of water, not 20.46 million.

I am glad to report that July rains have materially changed the water supply situation, almost daily spilling having been necessary since the Lake elevation reached + 85.5 on July 26, 1920. R. Z. KIRKPATRICK,

Chief Hydrographer, the Panama Canal.

Balboa Heights, C. Z., Sept. 14.

What Is Art?

Sir—I have just read your editorial under this title in your issue of 16th inst., referring to the unhappy mixture of engineering and "architecture" in our Bensalem Avenue bridge, and I respectfully dissent from your three conclusions: (1) "Just as the engineer asks of the architect an acceptance of his assurance of strength in a structure, so must he accept the architect's assurance of beauty." (2) "Unquestionably this structure is pleasing to look at and testifies in general to the wisdom of architectural assistance in bridge design." (3) "It is a fair question whether the engineer's instinct for simplicity in bridge design is not sound."

In regard to the first of these sentences, your judicial attitude does you credit, but it has misled you. The converse does not hold. The radical difference, between the engineer's and the architect's training, which makes the engineer the authority on strength, makes him also the authority on beauty. The engineer designs a truss bridge, beautiful because fitly performing its function; but, if the bridge is to appear in a public park or in some other place where large numbers of tasteless persons are expected to foregather, an architect must be called in, and he proceeds to "beautify" the design. He will pile on meaningless pylons, or he will erect meaningless rock fortresses at the portals, or he will throw a meaningless sheet-iron arch across each panel, or he will hang a meaningless cast-iron cauliflower at each panel-point; or (if unrestrained by an engineer) he may even perpetrate all these crimes upon a single structure. The man who, in "the pursuit of prettiness," spells "music" with a "v," or who builds a column under the keystone of an arch, thereby proclaims his failure to grasp the nature of beauty.

Judging from your photographs, the Bensalem Avenue bridge would be "pleasing to look at," as your second sentence claims, from a distance sufficient to hide its architectural disfigurements, but the bridge testifies to the unwisdom of letting the architect perpetrate them. Your text states that the arch rings increase in thickness from crown to the springs, as they should; being 2 ft. 6 in. at the crown, and 6 ft. 8 in. at the springs. This, if shown, would have been an element of beauty, for it accords with nature and satisfies the eye unperverted by "architecture"; but the photograph at top of p. 561 indicates that the architect has deliberately hidden this beautiful feature by a thin veneering of camouflage slabs, much deeper than the crown thickness, counterfeiting a flat-top arch, extending for some distance each way from the crown, and merging the arch (in appearance only) with the "ornamental" horizontal coping!

As to your third sentence, there is no question as to the soundness of the engineer's instinct for simplicity; for that instinct is based upon the nature of things.

In his address at the Denver convention of the American Society of Civil Engineers in 1908, President Charles Macdonald well said: "The structure which has been designed upon the most scientifically accurate proportions, that is to say, which accomplishes, in accordance with Nature's great law, the object for which it was intended, will present the most pleasing outline," and the addition of architectural scroll-saw work to that outline serves only to obscure and to belittle its beauty. JOHN C. TRAUTWINE, JR.

Philadelphia, Pa., Sept. 18, 1920.

Why Flat-Slab Action Is Not Understood

Sir—I note your editorial in the Aug. 12 issue (p. 289), in which you state that the theory of reinforced concrete flat slab design is anything but exact. You might add that the theory of reinforced concrete beams is likewise anything but exact.

The difficulties with both lie in the failure of the majority of members of the engineering profession to apply the elementary principles of mechanics thereto. Thus the trouble with determining coefficients in flat slabs is found in the failure to appreciate that if the slab is fixed the amount of positive and negative bending is equal. Hence the moment resisted over the support is to that between the supports as the respective moment areas divided by the moments of inertia, an elementary consideration which indicates clearly that no fixed rule of thumb is applicable to the wide variations in design commonly employed.

When the columns are not stiff enough to practically fix the slab at the support the rigidity of the column should enter into the computation.

The total bending moment is easily determined and separated from the twisting moment, if we consider the lines of zero shear. Thus, if the column were but a point the total applied moment from column to column would be WL/12. In a diagonal direction it would be WL'/16 in which L' would be the diagonal dimension. These values would be reduced in the ratio of the half span less the half diameter of the capital to the half span.

The resisting moment is another matter which is ordinarily treated in an incorrect manner. The bending is in two directions and the mechanical operation of such bending can be understood by taking a slice of a hollow rubber ball. If you bend it in one direction it flattens out in the other. In other words, two bending moments at right angles to each other mutually reduce the effect of each and if equal the resisting moment that it is essential to provide for is less than half that which it would be necessary to consider were the bending cylindrical.

The writer is of the opinion that in any well executed concrete design there should not be a discrepancy greater than 5 to 8 per cent between computed stresses and measured stresses. Such stresses, however, must be measured in a rational manner. The concrete when it cures is subjected to shrinkage stresses which prevent it from deporting itself in an elastic manner. Accordingly, recovery readings and not initial readings are those which determine the true stress. That this is obviously the fact will be apparent upon considering the case of a steel bar which has been stressed beyond the elastic limit. If we take a reading under the maximum load and note the recovery when the load is removed we can multiply the recovery difference in the readings by E, the modulus of elasticity, and determine approximately the load to which the bar has been subjected. We must do the same thing with the concrete. Then when the difference between synclastic and cylindrical curvature is taken into consideration there will be no difficulty in figuring true stresses, which will prove to be in harmony or keeping with measured stresses, and the data at present apparently inharmonious will assume a determinate and harmonious aspect. Establishment of Joint Committee assumptions or opinions will not matter. Painstaking application of the principles of mechanics and scientific procedure in testing only will accomplish this result.

One of the apparently indeterminate questions in flat slab design is that of arch action. Were the assumption of the ordinary theory correct that a plane section remains plane and normal to the curve of flexure after bending, arch action could not exist in a continuous beam or slab, but this assumption is in error. Horizontal shear deformation occurs, and, as this deformation in the simple span or cantilever increases as the moment area and decreases as the horizontal sectional area resisting it, the natural deformation or detrusion in the cantilever part of a fully restrained beam is greater than that in the suspended span portion. Hence a thrust is propagated along the under surface of the beam which develops arch action, an amount which is readily computed and permits the elimination of the last uncertainty or indefinite question presented by the flat slab problem or the continuous beam of reinforced concrete.

The settlement of these indeterminate matters is a question of pure mathematics—not a question of opinion or of vote by any committee of engineers. The popular tendency of late to introduce "real democracy" in the field of science, that is, to determine scientific facts by the votes of the members of a professional body instead of by painstaking application of mathematics and scientific methods, will never attain unquestionable results. C. A. P. TURNER.

Minneapolis, Minn., Aug. 19.

Highway Subgrade Study

Sir—In commenting on the letter of H. G. Shirley, regarding subgrades and foundations for highways, published in *Engineering News-Record*, Sept. 9, p. 521, one is reminded of the old English play "Our American Cousin."

"The proper study of mankind is man," and the proper study of the materials of the subgrade of a highway is the observation of them *in place*. In the glacial drift, which covers much of the northern part of the United States, occurs so much uncertainty in quantity as well as different quality that it is absolutely impossible to determine, from laboratory tests, how a certain patch of material will act in practice. (A patch of quicksand may be shallow or deep—a bed of quicksand may be overlaid by a thin sheet of high-grade gravel.) In glacial drift no two feet of a road layout are sure to be of the same material or to extend to the same depth, nor is it practicable to determine, by test-pits what underlies the surface stratum.

The only sure and practical way to determine the ability of the subgrade to carry the load to be imposed upon it is by the method described in an article on highways appearing in *Engineering News-Record* under date of March 21, 1918, p. 543. The Almighty has so constructed this old mother earth that some nature problems *must* be solved by the "cut and try" plan, and highway construction and maintenance is about as near to nature in all its parts as anything man has undertaken.

We have had a whole lot of "scientific" work exhibited on our highways and all or nearly all in the northern states are confessed failures. Why not begin now to study underlying principles and conditions and better those basic conditions before expensive hard surfacing is put on?

Many a foreman of a fifteen-man road gang knows more about the needs of the subgrade than any commissioner is showing signs of realizing.

By working highway layouts as improved dirt roads for a matter of two years, to prepare properly the subgrade, there will be found thousands of miles which need no more special treatment than oiling to harden them for use.

Where the materials are known they may be studied scientifically, but where they are unknown or imperfectly known the only possible method is by trial and elimination.

Jewett City, Conn., Sept. 16, 1920. A. A. YOUNG.

Remarkable Bridge Proposed for China

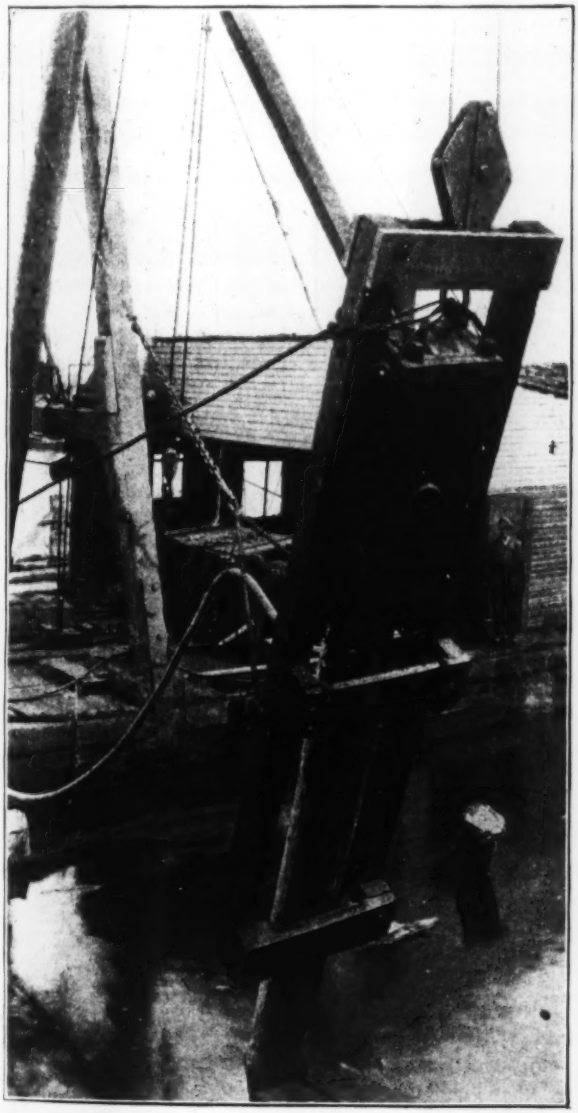
Plans are being entertained to build a combination reinforced-concrete girder and steel-truss cantilever bridge over Soochow Creek at Shanghai, China, according to note in *The Engineer* (London). An old wooden bridge now crossing the creek is to be replaced by a three-span cantilever bridge, built of reinforced concrete except that the suspended span is to be of steel. The central span is to be 120 ft. long and each of the side spans about 56 ft. The structure is to have a deck 56 ft. wide over all, and is to carry normal highway loading, with a 14-ton roller as maximum concentration. Incidentally, the pier will be skewed 14 degrees.

HINTS FOR THE CONTRACTOR

Derrick Boom Supports Leads For Steam Hammer Driving Batter Piles

IN THE construction of the barge canal terminal in Flushing Bay, Flushing, Long Island, the McHarg-Barton Co., New York City, has driven a large number of long foundation piles including several hundred spur piles, 17 to 19 in. in diameter and 80 to 85 ft. long, battered 1:3, by the use of swinging leads supported by a derrick boom. Piles are driven to an average penetration of 55 ft. through mud, clay and mud strata to bearing in a heavy blue clay, without the use of a pile driver tower or the elaborate mechanism often employed for driving battered piles.

The piles are set in position by a floating derrick and penetrate the mud several feet by their own weight.



DRIVING AN 85-FT. PILE WITH STEAM HAMMER IN SWINGING LEADS

The tops are guyed and pulled into position giving approximately the required angle at which they are maintained by the guy ropes while the pile is driven by a No. 7 McKiernan-Terry double-acting steam hammer making about 225 strokes per minute. The hammer weighs 5,000 lb. and the striking part weighs 800 lb. giving it a high efficiency which drives the piles at an average rate of 32 per 8-hr. shift. Piles were considered to be driven to the refusal point when they would not move over 1 in. under 100 blows of the hammer with steam pressure at 90 to 100 lb.

The pile hammer operates in a pair of 6 x 6-in. swinging timber leads, with 2-in. planking extending about 8 ft. below the butt of the pile, thereby affording a batter support. The leads and hammer are handled by a hoisting tackle operated from the end of a 78-ft. derrick boom which is very quickly adjusted to the required position for successive piles.

The water is 14 ft. deep at low tide and 20½ ft. deep at high tide, and the piles have a 6-ft. cutoff making an approximate total of 26½ ft. not driven.

This method of operating the hammer was designed, constructed and operated by J. S. Mosher, superintendent for the McHarg-Barton Co., contractors for the work.

Record of Rock Drills and Drill Work

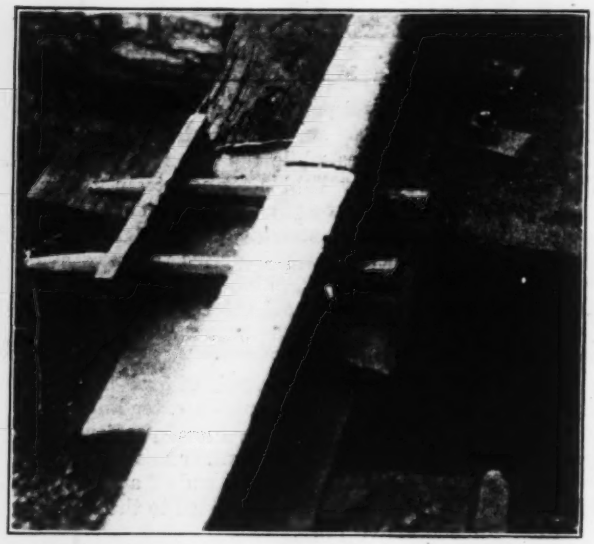
EFFICIENCY of drill steel in the Copper Range mines, Michigan, is promoted by records that show the actual underground performance of the drills. Reports from each drill machine are made daily by the shop and mine. Tables compiled from these reports show the footage drilled, steel broken, drills received and sent out at the shop, drills sharpened, and bits cut off. These data show what each machine or party is doing and whether the miner's supply of drills is kept up to date. The daily records show the number and condition of drills on hand at all times.

This system, which may be adapted to tunnel work, is described in a paper by H. T. Mercer and A. C. Paulson, Painesdale, Mich., read at the recent Lake Superior meeting of the American Institute of Mining and Metallurgical Engineers.

A Quick Assembly Rail Joint

THREE blows with a sledge disconnects the rail joint shown in the accompanying photograph. The clamp, two tapered pins and a flat tapered wedge, 4 in. wide, can be reassembled in two or three minutes by unskilled labor. The joint was devised because of the time required to assemble and dissemble regular splice bars, bolts and nuts on joints frequently made in a track carrying a pipe-laying machine at work on the new concrete water supply conduit for Denver, Col., described in *Engineering News-Record*, Sept. 16, 1920, p. 551.

The clamp passes under the end of the abutting rails. One side fits snugly under the rail head. The other edge is upturned and has two holes to receive tapered pins passing through the rails. Under these pins the broad



CONSTRUCTION TRACK RAIL JOINT WITHOUT BOLTS

wedge is driven against rail and clamp to hold the joint tight. Simplicity is desired as only three lengths of rails, which are spiked to 8 x 16-in. timbers, are used and the pipe layer is continually shifting the rails ahead. J. C. Mitchell, general manager Lock Joint Pipe Co., contractor, is responsible for the new device. P. H. Gentz, superintendent on the job, states that it works easily and satisfactorily.

Reuse Truck Runway for Delivery of Concrete Materials

IN those reinforced-concrete building constructions where material has to be brought in by truck inclined runways leading over the bins have been recently successfully used. One such structure, built by the Sam W. Emerson Co., general contractors, of Cleveland, Ohio, was so designed and erected as to permit its ready removal and consequently has been used on four separate jobs.

The runway is designed with two sets of track beams, each set consisting of a 10 x 12-in. and two 4 x 12-in. timbers in 28-ft. lengths. These timbers support two plank trucks, each about 2 ft. 6 in. wide, with a 6 x 6-in. curb bolted to the outside. The beams are supported by bents at 14-ft. centers, each bent consisting of a 6 x 6-in. upright and a 6 x 8-in. cap. The 10 x 12-in. timbers and the 4 x 12-in. timbers in the track beams are spliced at alternate bents.

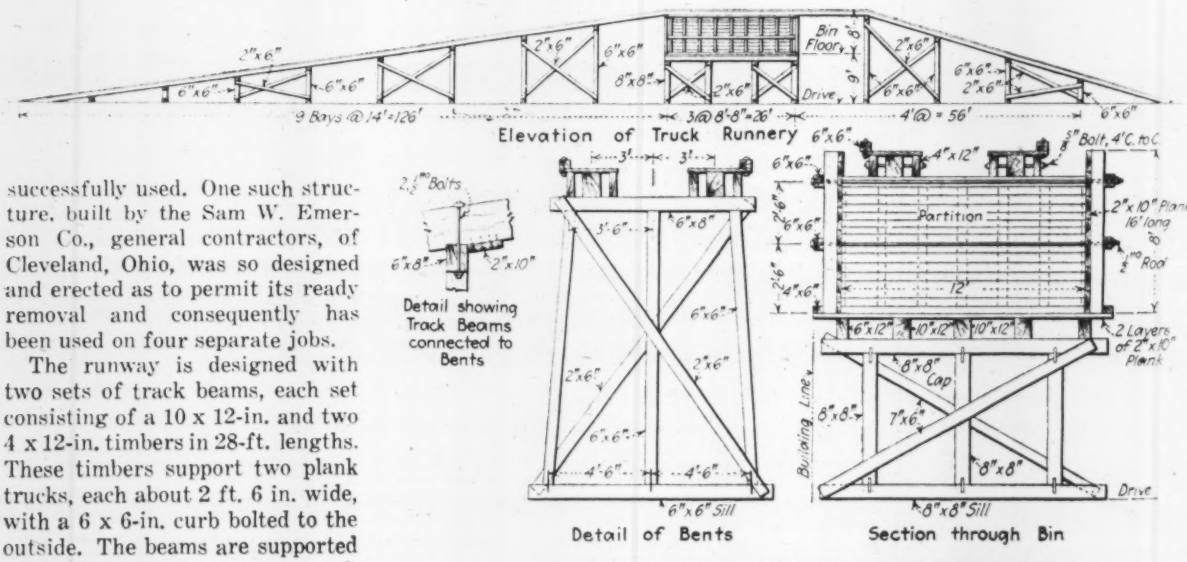
After reaching the top of the incline the loaded trucks dump into the sand and stone bin, the floor of which is 9 ft. above the ground. The inside dimensions of this bin are 12 x 24 ft. The floor is built of two layers of 2 x 10-in. plank, supported on 10 x 12-in. beams and the sides of one thickness of 2-in. plank. The partition which separates the sand compartment from the stone compartment is located 14 ft. from one end, which gives a stone capacity about 40 per cent greater than the sand capacity. The floor of the bin is flat. Two 24 x 30-in. gates in one side feed the sand and stone into a super-hopper, which discharges into the mixer. The axis of the mixer is about 4 ft. from the surface of the ground, and the tower bucket in its lowest position rests directly on the ground.

The runway was first used in May, 1919, on the building for the Forster Realty Co. in Cleveland. On this job, as a result, it was found possible not only to pour 175 yd. of concrete in an 8-hr. day with a ½ yd. mixer but to pour the entire building, 500 ft. long and four stories high, from a single tower, with only 18 ft. of space along one side.

The same runway has since been used in three other jobs and is still in good condition. When it is taken down to be moved all bolts are removed and the track beams completely taken apart. The bracing between the bents is removed but the bents are left intact.

Paving Work in Philadelphia

DURING the year 1919 sixty-one contracts involving $2,363,375.50 entered into in 1918 were finished, and 164 new contracts, valued at $1,826,757.42 were executed by the Philadelphia Bureau of Highways, Department of Public Works according to its annual report. The actual cash expenditures through the Bureau were $1,430,494.12 from current funds and $891,626.17 from loaned funds, a total of $2,322,120.29. The Department of Supplies expended for the Bureau of Highways for material $291,377.68, making a grand total of $2,613,497.97.



DETAILS OF DEMOUNTABLE TRACK RUNWAY

NEWS OF THE WEEK

New York, September 23, 1920

Congress Expected To Aid Construction Work

(*Washington Correspondence*)

That the next session of Congress reasonably may be expected to do all within its power to help the nation meet its construction problem is regarded as a certainty. It is believed that it will look with favor upon appropriations intended for studies to devise means of reducing costs.

One of the ways in which economies can be effected, it is believed, is by increasing efficiency in the mining and the handling of the non-metallic minerals. The construction industries alone will use non-metallic minerals to the value of $400,000,000 in 1920, it is estimated. It is believed that convincing information can be compiled looking to the substitution of mechanical equipment for hand labor and the practice by more operators of the short cuts which have been developed by the more highly organized companies. It is thought that much waste can be eliminated and that ways can be found to utilize unavoidable waste.

To Map Production Centers

It is suggested that centers of production of basic raw materials should be mapped, as well as centers of consumption, so that savings can be made on freight charges and rolling stock can be economized. The governmental agency charged with the work, in addition to disseminating such information as the fact that per-man production oftentimes can be increased seven-fold by substituting steam-shovel loading for hand labor, would undertake, for instance, to establish a nationwide use of standard screen sizes.

Limestone screenings are valuable for fertilizer purposes. Ways could be devised, it is believed, to utilize all limestone waste. Little research has been done on the mineral pigments. There is said to be much room for improvement in the technology of the calcination of gypsum. A useful brick is made from grinding granite waste and mixing it with lime, but few of this particular type of brick are made in this country.

The foregoing are cited to indicate possibilities of a methodical study of economies in the non-metallic minerals. The list could be extended almost indefinitely it is declared. The Bureau of Mines has been doing some work along these lines, but its activities have been incidental because of lack of appropriations and have been entirely inadequate to meet the demands of the construction industries.

Philadelphia Section, Am. Soc. C. E., Protests Changed Meeting

At a meeting Sept. 13 the Philadelphia Section of the American Society of Civil Engineers passed the following resolutions:

Whereas, the call for the Sept. 1, 1920, stated meeting of the American Society of Civil Engineers announced as the business the discussion of the paper entitled "Bridge versus Tunnel for the Proposed Hudson River Crossing at New York City," and on Aug. 30, the Acting Secretary of the society sent out a postal card notification, to members of the Board of Direction and to only resident members of the society, of the postponement of this paper and giving as the subjects for discussion, the proposed amendments to the constitution and the invitation to become a charter member of The Federated American Engineering Societies, and

Whereas, the reported account of the meeting published in the current issue of *Engineering News-Record* shows that it was participated in by only 99 members; that all of the discussion was opposed to the amendments, and to the acceptance of the invitation; that resolutions were adopted authorizing the minutes of the meeting in the *Engineering News-Record*, and requesting the Board of Direction through its Executive Committee to immediately issue copies of the stenographic report of the meeting to each member of the society, and

Whereas, the result of the questionnaire ballot canvassed, April 14, 1920, shows that the New York District, by a vote of 3 to 1, was opposed to the comprehensive organization recommended by the Joint Conference Committee of the four Founder Societies, which recommendation was approved, June 3-4, 1920, by the Washington Organizing Conference,

Therefore Be It Resolved, that the Philadelphia Section of the society, at a regularly called meeting, Sept. 13, 1920, notice of which meeting was sent to all of its members, hereby protests to the Board of Direction of the Society,—

(a) that the program of stated meetings should not be changed without due notice to each member of the society;

(b) that the meetings of the society should not be conducted as New York local meetings;

(c) that no business vital to the welfare of the society should be transacted unless each corporate member is duly advised, in advance, of the properly called meeting which notice should state the business to be considered; and

(d) that under no circumstances should the report of the stated meeting of September 1, 1920, be mailed, in separate form, to the members at the expense of the society.

Be It Further Resolved, that copies of this resolution be sent to the Board of Direction, and to each local section of the society, to the technical papers, and to all members of the society resident in the Fourth District.

Morgan Engineering Cos. Establish Shanghai Office

The Morgan Engineering Cos., Dayton, Ohio, will open an office at Shanghai, China, having been retained by Chang Chien, formerly minister of commerce and agriculture, as consulting engineers for shore protection, canal improvement, drainage and other important public works in the vicinity of that city. It is also the intention to investigate the possibilities of flood control, reclamation and power development work in China.

Bids Opened for Shafts of Vehicular Tubes

Thos. B. Bryson, With Total of $650,000, Is Low on First Contract for Hudson Tunnel Job

Five contractors submitted bids Sept. 21 for the construction of two of the ventilating shafts of the New York-New Jersey vehicular tunnel under the Hudson River, the tender of Thomas B. Bryson, amounting to a total (official) of $650,802.50 being low. The next lowest bid was that of Booth & Flinn, Ltd., at $695,000. The other three contractors were: Patrick McGovern, $922,000; Frederick L. Cranford, Inc., $950,000; and Rodgers & Hagerty, Inc., $1,244,000. The present contract is the first call for actual construction work to be made by the two state commissions created to administer jointly the project of providing a subaqueous route for vehicles between New York City and Jersey City. (See *Engineering News-Record*, Feb. 19, p. 357.)

The contract covers the construction of two ventilating shafts at the Manhattan end of the tunnel located respectively at Canal and Spring Sts., near Washington St. The shafts are rectangular and involve the sinking of two caissons consisting of steel walls filled with concrete. Measured to the outside of the cutting edge of the caisson, both shafts have sections 47 ft. 1½ in. by 42 ft. 5½ in. The inside dimensions, measured to the face of the skin plates, are 36 ft. 8 in. by 32 ft. The thickness of the concrete filling in the walls is 5 ft. 1½ in.

By the terms of the contract the contractor is allowed twelve months in which to complete the work. This time is believed by the commissions' engineers to be adequate, inasmuch as it is thought that actual construction need only consume six months, the other six months being leeway to provide for delayed deliveries of steel. A penalty of $1,000 a day is specified if the work is not finished within a year's time.

The principal quantities involved in the construction are: Earth excavation above mean high water, 870 cu.yd.; earth excavation below mean high water, 8,330 cu.yd.; rock excavation, 10 cu.yd. Concrete in caissons, 2,710 cu.yd.; concrete placed in compressed air, 770 cu.yd. Steel in caissons, 1,190 tons.

The shafts will form permanent ventilating openings connecting with the tubes. The present contract does not involve any equipment. The Spring St. shaft is about 54 ft. deep, while the Canal St. shaft is 60 ft. deep.

In their essential features the specifications follow former practice as exemplified in the New York subway work. In one detail, that of waterproofing, a change has been made. Cotton fabric and asphalt are specified instead of burlap and coal-tar pitch. It is believed that the hot asphalt in compressed air will give less trouble in the matter of fumes than the coal tar pitch.

As for concrete, there is a clause giving the engineer control over the mixture by varying the amount of stone, but the quantities of sand and cement are always to be constant.

The ventilating shaft contracts have been advertised in advance of the remainder of the work inasmuch as money for their construction is immediately available. Chief Engineer C. M. Holland emphasized to *Engineering News-Record's* representative that the type of ventilating shaft specified makes it feasible for the subsequent tunnel work to be done either by the shield process of by the trench method.

Presidential Candidates Favor Engineers' Program

Answers to questions on public policy relating to engineers and engineering submitted to Senator Harding and Governor Cox by the American Association of Engineers indicate that both presidential candidates favor the views of the engineers. The questions asked if the candiates favored (1) the establishment of a National Department of Public Works; (2) assembling and coordinating all federal engineering and construction (excepting the purely military works) in such a department; (3) appointment of an engineer on the Interstate Commerce Commission; (4) a progressive and constructive program of conservation and development of our natural resources; (5) a budget system; (6) reclamation of waste lands by drainage, irrigation, flood control and other methods; (7) giving the settler the advantage of procuring the land by a sound financial system such as is provided by a rotating fund.

Governor Cox writes L. K. Sherman, president of A. A. E., as follows:

> My reply to every one of the questions you ask is unequivocally "yes."
>
> Time will not permit, nor do I consider it proper that I answer the ordinary questionnaire. My past record and public utterances must be sufficient, however, as in the case of your letter, the reply to questions asked and my record and public announcements are one and the same. I therefore take great pleasure in making this statement.

Senator Harding's letter is more detailed in his reply to C. E. Drayer, secretary A. A. E.

> It is not an easy matter for me to make a detailed reply to the inquiries conveyed in your letter and I do not care to enter into a categorical reply to questionnaires, no matter how friendly they may be and no matter how r eputable and high-standing is the source from which they come.
>
> My theory of a campaign is that a man's candidacy ought to be based on the formal and public utterances, though, of course, we are all of us informal enough to discuss informally many of the problems which are in the minds of various groups of our American citizenship.
>
> I have had up the matter of the Department of Public Works in some personal interviews and quite agree with you that the question is an exceedingly interesting and important one. I fear I should be unworthy of public confidence if I ventured to decide so important and far-reaching a question without the very fullest study. It involves the reorganization of several departments. Undoubtedly there is necessity for this, but I should be very reluctant to unalterably commit myself to it without the very fullest of understanding.
>
> You may be interested to know that I have already sent for the Congressional hearings on this particular question.
>
> I may say, in a general way, that I think very well of the appointment of an engineer on the Interstate Commerce Commission and I have always spoken heartily in favor of a progressive and constructive program of conservation. I am sure you know that I favor the budget system and a very forward policy relating to reclamation and irrigation.

A. A. E. States Its Position on Federation

The following letter in reference to the position of the American Association of Engineers relative to The Federated American Engineering Societies, has been sent to Richard L. Humphrey, chairman of the Joint Conference Committee, by C. E. Drayer, secretary of A. A. E.:

> Careful consideration was given by the Board of Directors of the American Association of Engineers at its meeting on Sept. 11 to the invitation dated Aug. 25 of the Joint Conference Committee to this Association to become a charter member of the Federated American Engineering Societies.
>
> The American Association of Engineers, as expressed by its delegates at the Organizing Conference June 3 and 4, fully considered the idea of a Federated American Engineering Societies and its objects. It was then understood that as the purposes of A. A. E. and the F. A. E. S. are to deal with the non-technical activities of engineers, there should be devised an effective system of co-operation in order to avoid overlapping and duplication of effort.
>
> At the Washington Conference the representatives of A. A. E. brought out the fact that A. A. E. is already doing much of the work proposed for the F. A. E. S. and has in existence a successful "going concern" consisting of a central executive office, numerous subsidiary offices with paid help, and some 225 chapters and clubs. These facilities were offered to the proposed federation. Having already in existence this organization, necessary for its existence, the American Association of Engineers cannot be expected to delegate to another body the trust that has been placed in it by 21,000 members to do their welfare work. It therefore appears that the effective method of co-operation between F. A. E. S. and A. A. E. will be for A. A. E. to be represented in F. A. E. S. as a co-operating member, A. A. E. doing its share of the work with its own organization at its own expense. Likewise F. A. E. S. should be represented in the American Association of Engineers.
>
> We will therefore be glad to be represented at the November meeting and will designate a delegate upon our being advised that this plan meets with your approval. We will be glad to have you designate a delegate to the official meetings of A. A. E. and inform us his name.

Western Society Endorses State Regulation of Utilities

Following an extended report by its Public Affairs Committee on state regulation of public utilities vs. home rule, the board of directors of the Western Society of Engineers has gone on record as approving the state commission side of the argument. The board also recommends to the members and to the public that the Illinois Public Utility Commission be retained. Instead of impairing the law which created the commission it urges strengthening that law.

Canadian Engineers Meet at Niagara Falls

Advantage was taken of the concentration of engineering construction around Niagara Falls by the Engineering Institute of Canada in its professional session which was held at the Ontario city of that name, Sept. 16-18. On the Canadian side of the Falls are located the two largest projects now under way in Canada, if not on the continent, the Queenston-Chippawa power canal of the Ontario Hydro-Electric Power Commission and the reconstruction of the Welland Canal by the Canadian government to accommodate ocean-going ships. Both of these works are within easy distance of the Falls, and to each was devoted an afternoon excursion. Trolley cars leaving the hotel were run under their own power to construction tracks which parallel each canal, where they were switched over and drawn by the construction locomotives alongside the work so that the visitors had a unique opportunity of viewing all of the operations.

In addition, two sessions were devoted to papers describing the project. On the first day the meeting listened to an illustrated talk entitled, "The St. Lawrence Route and the Welland Ship Canal," by Alexander J. Grant, engineer in charge, Welland Ship Canal. This described in considerable detail the ship canal project which has been noted a number of times in past issues of *Engineering News-Record*. The second morning was given over to papers by members of the staff of the Hydro-Electric Power Commission of Ontario, describing the new 500,000-hp. hydro-electric development at the Falls. These papers were as follows: "Design of the Queenston-Chippawa Power Canal," by T. H. Hogg, assistant hydraulic engineer; "Hydraulic Installation of the Queenston-Chippawa Power Development," by M. V. Sauer, hydraulic engineer of design; "Electrical Features of the Queenston-Chippawa Power Development," by E. T. J. Brandon, electrical engineer, and a final summarizing paper by H. G. Acres, hydraulic engineer, entitled "General and Economic Features of the Queenston-Chippawa Power Development." For the first time these papers gave some of the underlying design considerations of the Queenston project and the general details of the installation. Abstracts of the papers will appear in later issues of *Engineering News-Record*.

On the final morning N. R. Gibson, hydraulic engineer of the Niagara Falls Power Co., Niagara Falls, N. Y., gave a demonstration of his new method of measuring the flow of water in closed conduits for determining the efficiency of hydraulic turbines. This method is also to be treated in some detail later in this journal.

On two days luncheon was given to the vistors at the Administration Building in Queen Victoria Park overlooking

the Canadian Falls. On the first day the Department of Highways of the Province of Ontario was the host, and the second day, the Park Commission. Besides these two functions, there was a dinner on the first evening and a banquet on the second, the two differing only in the formality of the occasion, so that for the two and a half days of the meeting the members were brought together at all meals, except breakfast.

The professional meetings of the Engineering Institute of Canada are a recent development, the one at Niagara Falls being the seventh. They are held at different parts of the Dominion so as to attract the membership from certain localities. One in August of this year in Banff was under the general direction of the Calgary Branch and one to be held in Halifax in October will be in charge of the New Brunswick Branch. The one at Niagara Falls was in charge of the Niagara Peninsula Branch. In each case the branch assumes full responsibility for the program, which is as a rule devoted to subjects of specific interest to the district where the meeting is held.

At the Niagara meeting there were well over 200 members and guests present, together with a great number of ladies who participated in all of the events, acting particularly as spectators in a series of interbranch baseball games held on Saturday afternoon.

Engineering College of Maryland University Reorganized

Linking up of its engineering work with the State Roads Commission and with the U. S. Bureau of Public Roads, and the appointment of A. N. Johnson, former consulting engineer for The Portland Cement Association, to be dean, are the first steps in the reorganization of the engineering college and the strengthening of the general engineering work of the University of Maryland.

An arrangement was recently completed with the Maryland State Roads Commission and the U. S. Bureau of Public Roads, whereby an engineering experiment station will be established here and run in connection with the engineering college, under the direction of the new dean. The new arrangement, effected after a series of conferences between John N. Mackall, chairman, State Roads Commission, T. H. MacDonald, chief of the Bureau of Public Roads, and Dr. A. F. Woods, president of the University of Maryland, will go into effect October 1, and Mr. Johnson will assume his new duties at that time.

A. A. E. to Vote on Increase of Dues

The board of directors of the American Association of Engineers has authorized a chapter referendum on the question of increasing the dues to $15. With it is a proposition to apportion a greater percentage of receipts to the chapters.

Engineers Participate in Public Health Convention

Many sanitary engineering phases of public health work were discussed at the forty-ninth annual meeting of the American Public Health Association held in San Francisco Sept. 13 to 17, but outstanding as leading topics were control of industrial-wastes disposal, sanitation of bathing places and garbage disposal by hog feeding. Engineering sessions had a representative attendance and there was a refreshing readiness to discuss papers. Under the chairmanship of Paul Hansen, this general discussion, reflecting opinions from widely different viewpoints, was crystallized into helpful suggestions to the several standing committees and specific instructions covering new lines of investigation were framed.

In the general sessions there was discussion of progress toward co-ordinating all federal health activity under central authority, with the eventual establishment of a department of health and a chair in the President's Cabinet. Hugh S. Cummings, surgeon general, U. S. Public Health Service, spoke in support of this plan.

Dr. M. P. Ravenel, University of Missouri, was elected president of the association for the coming year. In the engineering section Samuel A. Greeley, consulting engineer, Chicago, was elected chairman and Edward R. Rich, state sanitary engineer, Lansing, Mich., secretary.

The committee on waterway sanitation was instructed to consider particularly the destructive effect of industrial wastes on the biological action which affects the self purification of waters. Due to the great increase of such wastes attendant upon wartime industrial activities this was agreed to be perhaps the greatest problem now before the sanitary engineer.

The committee on bathing places has before it much important work, and outside aid in gathering necessary data was urged. It is to develop the technique of testing the sanitary condition of suits and towels, to study means of satisfactorily disinfecting them and to determine if possible what diseases may be transmitted by pool waters, particularly whether typhoid and venereal diseases can be so transmitted.

The refuse collection and disposal committee reported increasing favor for the tractor and trailer method of collection and for disposal by hog feeding. Hog feeding is an incomplete method of disposal, however, because there remains from 15 to 50 per cent of inedible material and hog manure may amount to more than 50 per cent of the garbage fed. The committee is to try to secure some expression of opinion as to what sanitary requirements are reasonable on hog farms where garbage is fed.

[The foregoing telegraphic report from this journal's Pacific Coast editor will be supplemented by a more complete account of the convention proceedings in a later issue.—EDITOR.]

State Commissions Organize for Rate Hearings

A special committee, representing some of the state railroad commissions has been organized to "safeguard" the interests of the state commissions in the hearings to be held on the application made by railroads asking the Interstate Commerce Commission to remove alleged discrimination against interstate commerce because of refusal of various state commissions to authorize increases in intrastate freight and passenger charges to the same extent that interstate rates have been increased.

The committee is composed of: Fred W. Putnam, member of the Minnesota Commission; H. G. Taylor, member of the Nebraska Commission; R. Hudson Burr, member of the Florida Commission; Joseph A. Kellogg, member of the New York Commission, Second District, and Joshua Greenwood, member of the Utah Commission.

Alaska Road Commission Is Reorganized

The Alaska Road Commission, as recently reorganized, is composed of Major James G. Steese, Corps of Engineers, president; Captain John C. Gotwals, Corps of Engineers; and Capt. C. S. Ward, Corps of Engineers, secretary and disbursing officer. The headquarters of the commission are located at Juneau, Alaska, and suboffices are maintained at Valdez, Seward, Fairbanks, and Nome.

The commission is now responsible for the maintenance of a system of wagon roads, sled roads, and trails, aggregating nearly 5,000 mi., including a connected system of 4,600 mi. reaching into all occupied parts of the territory, and several hundred miles of isolated stretches. About 1,050 mi. are classed as wagon roads. The system is being extended as funds permit.

Short Courses Give Two Hours' Credit on Master's Degree

A series of graduate short-period courses in highway engineering and highway transport offered for the winter of 1920-1921 by the University of Michigan, will be given in periods of two weeks each, each course to contain 30 lectures or the equivalent thereof and each course counting as two hours credit toward the total of twenty-four hours required for a master's degree. The practical equivalent, therefore, of a two-hour course running an entire semester is offered in these short-period graduate courses. In addition to the various highway engineering and highway transport subjects available to those registering for the graduate short courses, more complete details of which were published in *Engineering News-Record*, August 12, p. 333, a student will have the opportunity of participating in the seventh annual Michigan conference on highway engineering which will be held from Feb. 21 to 25, 1921, in the engineering building of the university.

Chicago Engineers Discuss Am. Soc. C. E. Amendments

Eighteen members of the Illinois Section of the American Society of Civil Engineers, at a meeting in Chicago, Sept. 17, discussed the proposed amendments to the constitution. Few arguments were presented other than those brought out at the meeting of the New York Section, as reported in *Engineering News-Record*, Sept. 9, p. 525.

T. L. Condron stated that when the ballot first came to him he was inclined to favor most of the amendments, but after spending a day's time investigating the situation, interviewing several members and reading the report of the New York meeting in the technical journals he had come to the conclusion that most of the amendments had not been given sufficient consideration, were not well correlated with other portions of the constitution and that inasmuch as a committee of the Board of Direction was at work upon a set of amendments, which would have behind them legal advice to avoid the taxation feature and the inconsistencies, it would be wise to "clear the deck" by rejecting amendments A, F and G. A resolution substantially in accordance with Mr. Condron's views was passed unanimously.

E. S. Nethercut had made a plea for the adoption of amendment C, calling for an increase in the dues of non-resident members so that this added income might become available Jan. 1, 1921. Every speaker held that more money must be collected.

G. H. Bremner and Murray Blanchard were in favor of the amendments on the general ground of doing something now. "If it accomplishes nothing else it will stir up interest in the organization," said Mr. Bremner. Sutton Van Pelt was in favor of immediate action.

In discussing amendment F, Mr. Nethercut voiced opposition to having more than one past-president on the board. It is his opinion that a past-president's only function on the board should be to carry into a succeeding administration knowledge and advice as to past actions and policies, all of which should be sufficiently well in hand by the end of one year. If then he was wanted on the board he should be elected.

American on Australian Railway Gage Commission

The State Department at Washington has announced receipt of advice from the American consul-general at Melbourne that the Australian ministry had decided to secure the services of a railway expert from this country and another from England, to act with an Australian railroad man as chairman, in an investigation of uniform railway gage. There are three different gages at present. An article on the subject appeared in *Engineering News-Record*, Aug. 5, 1920, p. 255.

Federation's Council To Meet for First Time

The first meeting of the American Engineering Council, consisting of representatives of member societies of the Federated American Engineering Societies, will be held in the New Willard Hotel, Washington, D. C., Nov. 18, 19 and 20. The morning session of Nov. 18 is to be a business meeting. In the afternoon, after an address by J. Parke Channing on "Engineering Council," there will be a discussion of the field of activity for the federation.

Committee reports and election of permanent officers will occupy the morning and afternoon sessions of Nov. 19. In the evening Herbert Hoover will address the meeting.

The Executive Board of the American Engineering Council will hold an organization meeting at 9. a.m. Nov. 20.

San Francisco Contractors Charged With Conspiracy

The secretary and five members of an "inner ring" in the Team and Auto Truck Association of San Francisco were indicted Sept. 13 for manipulation of bids on grading contract in that city. A grand jury investigation was started when a contractor who said he had refused to join the ring claimed illegal pooling and boosting of bids. Twelve per cent was added to all bids, he said, to be put into a "kitty" or secret fund. Contractors among the accused admit the addition of a percentage on certain bids, but assert that this is "a strike fund which is used to protect our members in case of labor trouble." The scandal has been occupying generous front-page space daily in San Francisco newspapers.

Rehabilitating Cantonments

The shifting of several Army divisions, made necessary by the abandoning of certain camps, has brought the Construction Service face to face with the difficult problem of rehabilitating housing at the camps to which the divisions have been ordered. For instance, the division at Camp Taylor has been ordered to Camp Dix. The buildings which the division will occupy at Camp Dix have been unused for a considerable period and are badly run down. To put these buildings in shape to house the men this winter will be a difficult task, it is stated at the Construction Service, when the limitations of personnel and funds are considered.

All-American Canal Survey Begun

A survey and general investigation of the proposed All-American Canal to serve the Imperial Valley has been begun by the U. S. Reclamation Service. W. W. Schlecht, the project manager at Yuma, is in immediate charge of the work. Local interests recently raised $40,000 to add to a Federal appropriation of $20,000 to defray the costs of this survey.

Recent Activities of American Association of Engineers

Almost 3,000 men were referred to positions in August by the service department of the American Association of Engineers. The average salary of the 306 men placed through the efforts of the national and branch offices was $209 per month.

At the recent convention of the Washington State Assembly in Everett a committee was appointed to arrange with the state educational institutions for extension courses for members. A recommendation was made that county engineers be appointed instead of elected, that they have full charge of road funds and that their salaries range from $3,000 to $6,000.

The San Francisco chapter has engaged a full time secretary with offices at 960 Pacific Building. This is the ninth field office established in addition to the one at Omaha for which no quarters have as yet been found.

Chapters in Arizona are preparing a license bill to be introduced into the next legislature.

The Interstate Commerce Commission has advised the association that its request has been granted for a hearing relating to the interpretation of the term "engineer of mechanics" under which professional engineers have been classed. The question to be decided is whether or not mechanical and electrical railway professional engineers are to be included under this classification of subordinate officials which was established last March.

Railroad sections of A. A. E. have been notified of increases in salaries of engineering employees on the Union Pacific, Burlington, Kansas City Terminal, Missouri, Kansas & Texas, Great Western, Boston & Maine, Pennsylvania and several other railroads.

Katherine M. H. Blackford, character analyst, New York City has accepted appointment on the national employment council of A. A. E.

National Convention of Free Employment Heads

As a means of determining how free employment agencies can best serve engineers and employers of engineers the American Association of Engineers is sponsoring a national convention of free employment representatives to be held Nov. 12 in Chicago. All engineering societies or other agencies maintaining free employment service are invited to participate.

Many Seek Engineer Commissions

The results of the examinations for appointment as commissioned officers in the regular army are now being made public. There were more applications per vacancy for engineer commissions than for commissions in any other branch of the service. There were 432 applicants for the 96 commissions which can be granted in the Corps of Engineers.

Philadelphia Favors Amendments

The following resolution was passed, Sept. 13, by the Philadelphia Section of the American Society of Civil Engineers:

Whereas, proposed amendments to the Constitution represent the two years effort to inaugurate a progressive policy in the American Society of Civil Engineers, and amendments "A," "B," and C" are based upon the recommendations of the Committee on Development which were approved by a more than 2 to 1 vote of the Society, April 14, 1920, nearly fifty per cent of the members voting,

Therefore Be It Resolved, that the Philadelphia Section of the Society at this September 13, 1920, meeting, endorse, and urge each corporate member to vote YES for the proposed amendments, thus making effective the recommendations of the Committee on Development;

Be It Further Resolved, that copies of this resolution be sent to each local section of the Society, to the technical papers, and to all members of the Society resident in the Fourth District.

Larger Reclamation Fund for Next Year

Due to the enactment of the oil land leasing act, and to the increase in the repayments for past construction, the U. S. Reclamation Service fund will make possible a larger expenditure on reclamation projects during the next fiscal year. The appropriation which is available during the current fiscal year is approximately $9,000,000. It is expected that at least $5,000,000 can be added to the appropriation for the next fiscal year.

In addition there is considerable sentiment in favor of asking Congress to make a liberal loan to the Reclamation fund, the loan to be repaid later, as in the case of the loan of $20,000,000 in 1910. The chances of securing this loan are believed to be enhanced by the pledges which are being made by the presidential candidates. Regardless of this loan the increase in the reclamation fund will enable the U. S. Reclamation Service to take up important new construction work in connection with existing projects. It is probable that new work will be undertaken on the Shoshone project in Wyoming where storage water already is available for new units.

On the North Platte project in Nebraska and Wyoming there is urgent demand for more funds to push construction on the Ft. Laramie Canal. This canal eventually will water 100,000 acres. At a recent opening of a small unit under this canal there were 40 applicants for each farm and the applications were limited to former soldiers.

On the Rio Grande project and on a number of others there is an insistent demand for the construction of drainage systems. A large amount of drainage has been put in, but the work on the irrigation system is somewhat ahead of drainage operations.

On the Yakima project in Washington an additional large storage reservoir is being constructed as the land under cultivation has extended to the point where the present facilities are inadequate.

Chemists Decline To Affiliate

The Council of the American Chemical Society at the semi-annual meeting in Chicago Sept. 6 to 10 decided that the society could not affiliate with the Federated American Engineering Societies. It was pointed out that the financial obligations which would be incurred through affiliation would be impossible under the present circumstances and it was urged that the chemists should co-operate upon an independent basis rather than affiliate with the tendency to subordinate the chemical activity to strictly engineering service.

A resolution was also passed by the council urging that local sections of the American Chemical Society refrain from affiliating with other local engineering and technical societies in state or district federations.

Bishop Leaves Indiana State Highway Department

Owing, it is stated, to a disagreement in policy with L. H. Wright, director of the department, H. K. Bishop has resigned as chief engineer of the Indiana State Highway Department. It is understood that several changes in personnel either have been made or are to be made in the department. Mr. Bishop's place is being temporarily filled by C. Gray, former chief of the bureau of contracts of the highway department. Before his appointment as chief engineer of the Indiana Highway Department Mr. Bishop was a district engineer with the United States Bureau of Public Roads.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF PORT AUTHORITIES. Montreal; Chicago, Sept. 30-Oct. 2.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Valparaiso, Ind.; St. Louis, Oct. 10-15.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION. Chicago; Atlanta, Ga., Oct. 26-28.

NATIONAL DRAINAGE CONGRESS. Chicago; Atlanta, Ga., Nov. 10-12.

The Engineers' Society of Western Pennsylvania, at its regular monthly meeting, held in Pittsburgh, Sept. 21, listened to a paper entitled "Small Steam Turbines," by W. J. A. London, president of the Steam Motors Co., Springfield, Mass. The paper was illustrated by lantern slides.

The Engineering Society of Western Massachusetts held its fall meeting Sept. 21 at the General Electric Co. Works, Pittsfield, Mass. An inspection trip was made through the G. E. Works, particular attention being given to motor construction. Among the speakers at the meeting were L. F. Adams, of the Power Mining Department, G. E. Schenectady Works, on "Motor Application," and Neal Currie, head of the G. E. Pittsfield Works, whose subject was "Principal Characteristics of Various Kinds of Motors."

The Texas Section, Am. Soc. C. E. will hold its fall meeting in Austin, Oct. 20 and 21. The following papers will be presented: "Concrete Construction" by G. G. Wickline, bridge engineer, State Highway Department; "Probable Flood Discharge of a 48 Square Mile Area Near Paris, Tex." by Major John B. Hawley, consulting engineer, Fort Worth; "Early Irrigation in Texas" by E. P. Arneson, consulting engineer, San Antonio; "Manufacture of Pipe and Clay Products Used in Sewer Construction" by M. C. Erwin, sewer engineer, City of San Antonio; "Contributing Factors to the Increasing Cost of Road Building" by T. H. Webb, State Highway Department; "Presentation of and Discussion on 'Standard Form of Contract with Arbitration Clause'" by Major John B. Hawley; "Organization and Progress on the Dallas Levee District" by E. N. Noyes, district engineer, and secretary-treasurer of the section.

Civil Service Examinations United States

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission for Form 1312.

Highway Bridge Engineer, $2,400 to $3,000 a year.

Junior Highway Bridge Engineer, $1,500 to $2,220 a year.

Master Computer, $1,800 to $2,400 a year.

Computer, Grade I, $1,400 to $1,800 a year.

Computer, Grade II, $900 to $1,400 a year.

Canada

Application forms may be obtained from the office of the Employment Service of Canada, or from the Secretary of the Civil Service Commission, Ottawa.

Supervisor of Timber Tests, $2,700 to $3,180 a year.

File application not later than Oct. 8.

PERSONAL NOTES

CLARENCE B. HOOVER has been appointed engineer in charge of the bureau of water-works extensions of Columbus, Ohio.

HENRY J. DARCY, Oklahoma City, has been appointed state sanitary engineer of Oklahoma. He succeeds J. W. Evans, who has resigned to enter private business.

M. O. BENNETT, division engineer, Oregon State Highway Department, Pendleton, Ore., has resigned to take up farming at Lewistown, Mont. His tem-

porary successor is R. H. Baldock, who has held a similar position with the state highway department in Baker, Malheur, Harney and part of Grant counties.

J. B. McANDREW, St. Catharines, Ont., has been appointed by the Canadian Civil Service Commission structural engineer for the Welland Ship Canal.

RALPH ARNOLD, Martinez, Cal., has been appointed highway engineer of Contra Costa County.

O. N. POWELL, Dallas, Tex., has been appointed engineer of Nueces County, Tex., succeeding H. A. Stevens, resigned.

EMORY W. LANE has gone to Shanghai, China, as Eastern representative and manager for the Morgan Engineering Cos., Dayton, Ohio, to study the question of flood control, land reclamation and water power development.

SITEMAN & COOPER, civil engineers, Paxton, Ill., have opened new offices in the Federal Reserve Bank Building, St. Louis, Mo.

JOHN A. BRUCE has resigned as city engineer of Omaha, Neb., and will return to private business.

STANLEY M. HANDS, former city engineer of Iowa City, has organized and incorporated the River Products Co., to handle building and paving rock from Iowa river quarries. Mr. Hands is president of the company.

A. E. WARREN, general manager Western lines, Canadian National Rys., has been made also general manager of the Grand Trunk Pacific Ry.

SIDNEY W. COOPER, since the close of the war connected with the New Jersey State Highway Department, has been appointed assistant division engineer, 4th division, Alabama Highway Department, located at Selma, Ala. Previous to the war for a number of years he was a drainage engineer in the U. S. Department of Agriculture in charge of work in the southwestern states.

COLONEL E. B. CUSHING has retired as engineer of maintenance of the Southern Pacific Lines in Texas and Louisiana after 40 years of service with the company. He will be succeeded by H. M. Lull, at present division engineer of the Southern Pacific at Portland, Ore., who takes title as chief engineer of the Southern Pacific Lines in Texas and Louisiana and assumes the duties of engineer of maintenance of way and structures. Colonel Cushing graduated from the Agricultural and Mechanical College of Texas in 1880 and entered railway service as instrumentman on the location of the Galveston, Harrisburg & San Antonio Ry. From 1881 to 1883 he assisted in locating and constructing the Mexican International R.R. to Palla, Mex. From the latter year until 1885 he was again with the Galveston, Harrisburg & San Antonio as division engineer, and later as contractor of masonry and bridge construction. In 1887 he entered the service of the Gulf, Colorado & Santa Fé as office engineer and chief clerk of construction, and in 1888 attained the grade of engineer of roadway. A year later he went to the Texas & New Orleans and the Galveston, Harrisburg & San Antonio, as resident engineer. In 1897 he became general superintendent of the Houston, East & West Texas and later, in addition to his other duties, was made chief engineer. He entered the service of the Sunset Lines as engineer maintenance of way in 1901 and attained the grade of chief engineer of construction in 1908.

OBITUARY

HAYDEN LEWIS DEMERITT, Government engineer in the Rivers and Harbors service, with headquarters in San Francisco, died, Sept. 7, at Oakland, Cal. He was a native of Rhode Island and was 71 years of age. Captain Demeritt had lived in California for 40 years. He was in charge of construction work on Government projects in San Francisco Bay and on the Sacramento and San Joaquin Rivers, and many years ago was identified with the U. S. Geodetic Survey, stationed at Reno, Nev.

GEORGE LEIGHTON, civil engineer, who was engaged in the design and construction of the Pennsylvania tunnels under the East River, New York, the East Shore Terminal at Charleston, S. C., and the construction of two sections of the New Jersey cutoff of the Lackawanna R.R., died, Sept. 13, at Glenburn, Pa., in his sixty-second year. He was born at Waverly, Pa., and was a graduate of Lehigh University. Mr. Leighton also aided in the construction of the Rockport tunnel of the Lehigh Valley R.R. and the tunnel for the Croton Aqueduct. He was assistant engineer on Washington Bridge, New York, made examinations and borings on the line of the proposed Cape Cod Canal, and did considerable location work for the St. Louis, Keokuk & Northwestern R.R. For several years Mr. Leighton was in private practice at Scranton, Pa., engaged on sewerage, water-works, railroad and mine surveys.

COLONEL CHARLES NEVILLE, during the war chief of the Accounting Division of the Construction Division of the United States Army, was killed in the explosion in Wall St., New York City, Sept. 16. Previous to entering the Government service Colonel Neville was traffic manager of the Stillmore Airline Ry., general freight and passenger agent and auditor of the Coast & Piedmont Ry., vice-president of the Brinson Ry. (now the Savannah & Atlantic Ry.), and subsequently practiced as a public accountant in Savannah, Tampa and Birmingham. He was senior partner of Neville, McIver, Barnes & Co., certified public accountants, and a member of the American Institute of Accountants. During his period of Government service he had full charge of policy, organization, commissions, civilian personnel, requests for commissions, travel orders, etc., and acted for the chief of the Construction Division in all accounting matters. Colonel Neville was born in New York City in 1875.

BUSINESS NOTES

DWIGHT P. ROBINSON & CO., INC., have recently established a branch office in Youngstown, Ohio, in charge of C. I. Crippen.

THE EASTON CAR & CONSTRUCTION CO., Easton, Pa., has opened a branch office in the Railway Exchange Building, Chicago.

CHRIS D. SCHRAMM & SON, INC., 709 Arch St., Philadelphia, Pa., announce that in future their administration offices will be located at West Chester, Pa., where the factory is situated. The company's Philadelphia office will be retained as a sales force only.

Concrete Support for Telegraph Poles

The type of concrete support for telegraph poles shown in the accompanying illustration is used on the Loetschberg Railroad, in Switzerland, for the obvious purpose of doing away with the decay usual when timber posts are set in the ground. On the Wengeralp Railroad, also in Switzerland, the holding device is entirely of steel set in a concrete foundation.

CONCRETE BASE FOR POLE